Heating and Ventilating

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

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CONTENTS

Cover ..... See page 38
Practical Piping Data on Modernizing ..... *John A. Masek* 9
Are Winters Getting Warmer? ..... *R. M. Nee* and *D. S. Boyden* 13
Training Pipe Welders 15
Heating and Ventilating Portland's Art Museum ..... *W. E. Kemery, Jr.* 16
Air Conditioning a Small Store for 16 Cents per Hour 19
Steam Service Control Reduces Over- and-Under Heating ..... *P. A. Hyde* 20
Development of Low Cost Housing in Europe 23
Proper Planning and Layout Methods Cut Pipe Welding Costs ..... *D. W. Hickey* 24
New Light on Heating System Corrosion ..... *J. H. Walker* 28
Selecting the Design or Outside Temperature for Heating Calculations 33
Philadelphia Conducts Aggressive Renovizing Campaign 36
Heating and Ventilating Airplanes Without Noise 37
New Construction Developments for Standardized Homes 38

DEPARTMENTS

Editorials 39
Abstracts 40
H. & V.'s Reference Data—9 and 10, Estimating Weights of Ducts, ... Opposite page 42
Your Everyday Problems 43
News of the Month 44
New Equipment 49
Degree Days for March, 1933 54
The Weather for March, 1933 56

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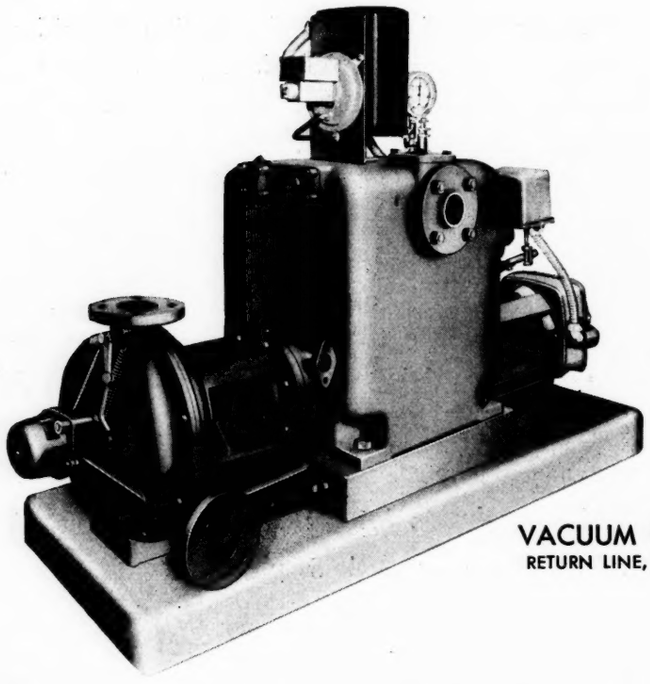

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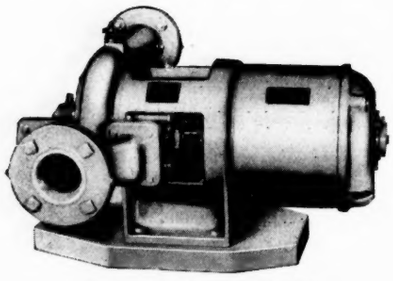

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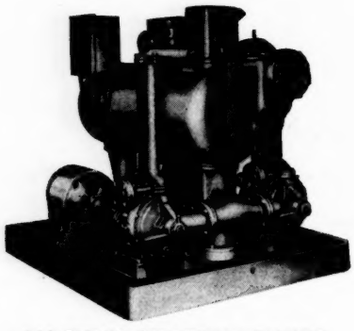

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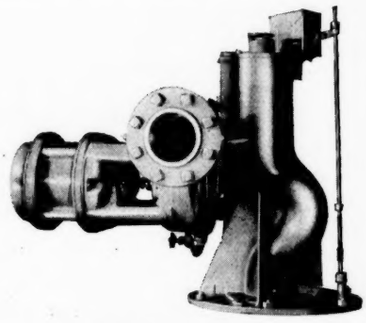

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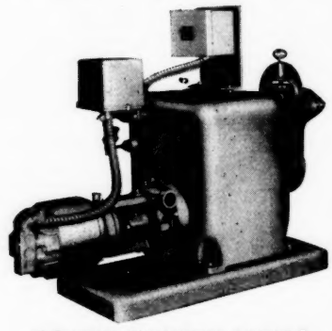

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Practical Piping Data on Modernizing

By JOHN A. MASEK

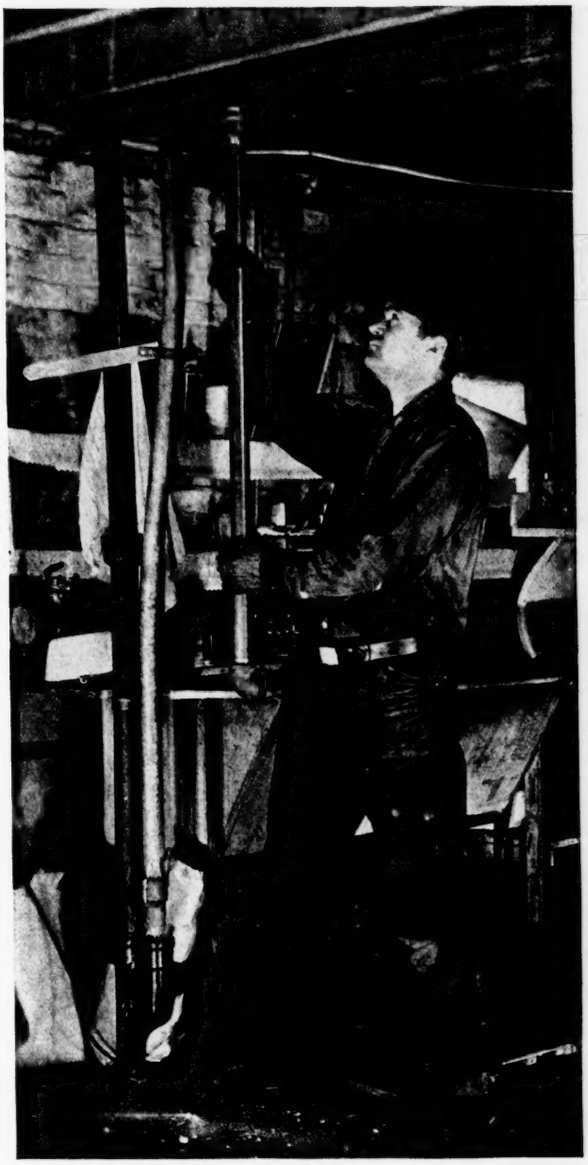

Fig. 1. Erecting a riser pipe after it has been coupled together and the bottom fittings screwed on. Pipe is being pushed up to a second fitter on the second floor who will fasten it in place.

MANY a contractor has been discouraged from making the most of modernizing possibilities because of some past experiences where labor costs exceeded the estimate. *A contractor doing modernizing should employ steamfitters who are specialists on alteration work.*

Only a first-class installation should be quoted on. While an owner may accept a cheap, exposed riser job, he is certain later to regret the unsightly pipe. Tenants complain that the exposed piping kills floor space, and women with sleeveless dresses burn their arms.

Preliminary Considerations

Before laying out a steam or hot water heating system where concealed risers will be an important consideration a survey of the premises should be made. The steamfitter should have a knowledge of building construction and an understanding of what timbers are concealed, and similar details. Every riser should be planned in advance, noting the floor beams and obstructions before making any openings. Timber locations are easily found by sounding along the wall or floor with a hammer. Windows and general arrange-

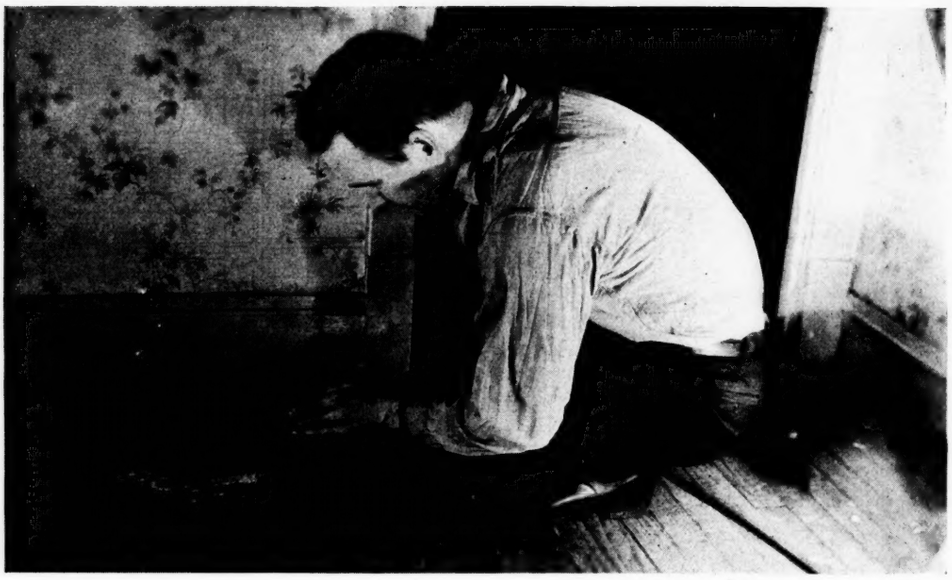

Fig. 2. One method of cutting across the floor that is to be taken up. A special half round saw is used.

ment of the furniture and closets should be observed. Radiator locations should be planned so as to fit in with the furniture placement. By a careful analysis of the building it is frequently possible materially to economize on labor and material.

Working Tools and Equipment

Tools required, other than the standard set of steamfitters pipe tools, include a slow-speed electric drill operating at or less than 400 r.p.m. with a complete set of long wood bits and drills. An outlay of $50 for these tools will more than pay for itself on one or two jobs. A "search" or ship auger about ¼ in. diameter and 24 in. long should also be provided. Several wood chisels about 18 in. long will be found necessary. A special half round floor saw is a handy tool to cut across floor boards that have to be taken up (see Fig. 2). A keyhole saw should also be included, together with a number of small crowbars.

Concealing Risers

Concealed risers are invariably placed in the inside walls. Outside walls cannot be used due to insufficient space and, if there were space, pipe covering would be necessary. Inside wall risers do not have to be covered.

To clear the way for the risers it is necessary to drill or cut a hole in the flooring between the partition (see Fig. 3). This can be done from the basement. Before drilling a large hole through a floor or wall partition, it is very desirable first to drill with a search auger to avoid accidentally going through unintended places. Holes cut and not used detract from good workmanship.

In order to run a pipe from the basement to the second or third floor the fitter will have to either remove some flooring or plaster. Some men do all this work by removing the baseboards and then taking up the flooring where necessary, avoiding touching the plaster.

There are other fitters who are very successful in not taking up any more flooring than necessary, but remove the necessary ceiling plaster, thus avoid touching the baseboards. It is easier to take down plaster and replaster it than to take up the flooring. With this procedure it is far more convenient to place radiators where they rightly belong. After the plant is installed, the plaster replaced, and the room redecorated, no evidence of this removal will be visible.

Replacing plaster should be done only by a person familiar with plastering patch work. To repatch a plastered ceiling with only one layer of plaster as is often attempted will leave a permanent mark.

The proper procedure is to apply the rough plaster first and allow it to dry overnight before putting on the finishing layer the next day. One method is to prepare the rough plaster by mixing a little portland cement with it to give it a hard body when dry. The final lime slow-drying white surface applied the next day is well troweled and frequently dampened with a brush so as to compress it, and this gives it a smooth even surface that will line up with the old plaster.

The cost to replaster the walls and ceilings, after the steamfitters' work is completed and tested, for the average two-story building will be from $15 to $25. If highly finished or inlaid floors and baseboards had to be replaced the costs would be higher.

Making Up Risers

A complete one-story riser leading to the second floor is always made up in two pieces, joined together with one coupling (see Fig. 4). To make up an average riser both pieces of pipe can be cut to a length of 5 ft. One piece is threaded on both ends while the other is threaded on one end. These pieces are coupled together while the upper piece is in the partition. The riser is then shoved up in place and the proper cutting length is marked on the unthreaded end. The pipe is then taken down, threaded, and recoupled permanently. After the bottom fitting or elbow is screwed on it is shoved up from the bottom, and the other steamfitter above fastens it in place (see Fig. 1).

To insure against leaks at the couplings after being installed between the walls, regular malleable couplings (usually recognized by the bead) should be used on all hand-made threads.

A mistake is sometimes made in using the wrought-iron couplings furnished on the ends of lengths of pipes as supplied. If these are the only couplings available the pipe should be cut so that the manufacturer's thread will be screwed into this coupling or a long

thread made. These precautions will eliminate taking the risers out because of leaks after the job is completed.

After reaming the ends of the pipes it is good practice to form the habit of looking through the ends of the pipes to see if there are no obstructions. A piece of stone or mud lodged in the pipe when unloaded and unwittingly installed can be the cause of endless grief for the contractor before the cause is located.

Beams

In most buildings the beams in the basement are usually placed far enough to one side of the wall partition as to make it possible to shove the riser pipe up. Sometimes the beam is squarely under the wall partition. A good way to get the pipe up is to drill a 2-in. hole vertically through the center of the beam. This hole is large enough to pass each piece of pipe one at a time through the hole, and this hole will not weaken the beam materially. The fittings or couplings are screwed on the pipe threads in the space between the floor and the beam. As the succeeding pieces of pipe are shoved through the hole it is coupled just over the beam before it is sent up.

Connecting the Radiators

After the riser is up the horizontal branches are run to the radiator. This is accomplished either by taking up the flooring, or by removing the ceiling plaster below the radiator where the riser extends. The latter in most cases is the easier method. All laths that are removed are cut and taken off from joist to joist. This permits new laths to be nailed on later.

In the case of hot water radiators on the first floor, the supply and return are connected in the customary manner, that is at opposite ends. With second and third floor radiators, the feed and return are placed on the same side, top and bottom openings of the end of the radiator nearest the risers. This saves a lot of tearing up without affecting the efficiency of the radiator.

Holes for the horizontal branches are made by drilling several holes in the form of a square with a ¾-in. drill. To do this the drill is held at an angle because the other joists are in the way. After a sufficient number of holes have been drilled to pass the pipe the center part is knocked out with a hammer. Notching or cutting away the joists at the edges should be avoided, as this tends to weaken them.

The horizontal pipe extending past several joists is made up in 24-in. lengths which are shoved through the holes and coupled together, the same as for risers. Pitch elbows should be employed wherever necessary to insure against pockets. After the risers are connected to the radiators they are again connected to the main with railroad unions in the horizontal branches in the basement (see Fig. 5).

Sizes

In planning the layout of radiators and risers it is an advantage to connect two radiators to a riser to save time and material. Under ordinary conditions, four riser runs in wall partitions will be required for the average six-room apartment.

For the usual hot water heating system in a two-story building, a 1½ in. will supply the living room and bedroom. The former will have a 1¼-in. valve, the latter a ¾-in. or 1-in. valve. If the living room and sunporch adjoin, a 1½-in. riser will do for both. Two bedrooms can be connected to a 1¼-in. riser and branched off with ¾-in. or 1-in. valves. An individual bathroom will require a ¾-in. riser. A separate bedroom can be handled with a 1-in. riser, reducing it at the top if a ¾-in. valve will be used. The average kitchen usually takes a 1¼-in. riser. On a three-story building the same sizes will hold for the top floor, while the risers feeding to the second floor should be increased one pipe size. A 1½-in. riser is the largest size pipe that can be put in walls.

These sizes are for average conditions but naturally the load determines the actual pipe size. When a one-pipe steam heating system is to be installed approximately the same pipe sizes will be used, but the minimum valve size would be 1 in.

Fig. 3. In order to make openings for the risers to be put through the wall partitions several holes are drilled so that the center can be knocked out.

Obstructions in Walls

Cross pieces or bridges in wall partitions usually nailed midway between the floor and ceiling are sometimes encountered. Some fitters remove these obstructions by cutting a hole in the plaster wall. This involves damaging the wall which must later be repaired.

Others have been successful in dislodging the crosspiece by forcing it out with a heavy automobile jack. A 1¼-in. or 1½-in. pipe extension is used between the obstruction and the jack.

Another method is to drill a number of holes through the crosspiece large enough for the risers to pass through. This is accomplished with a 1½-in. or 2-in. wood bit fitted to a pipe extension.

Neatness

The necessity of neatness in a finished building need hardly be mentioned. A heavy canvas cloth should be spread on the floor where working. Sometimes plain tar-paper will do. The plaster removed from the ceiling should be caught in a cardboard box instead of allowing the pieces to fall to the floor.

Removal and replacement of baseboards should be done with care. Baseboards can be taken off by punching the nails through with a fine nail set to avoid splintering. After the boards are pulled off the remaining nails should be cut off with a cold chisel at the backs so as not to mar the surface. The quarter-round pieces should be handled in the same manner.

Radiators should be carried in the home on a rubber wheel dolly. Holes for the radiator pipes should be drilled so that when the radiators are connected they will be centered with sufficient space between them and the wall and window.

Fig. 4. Riser pipes usually have to be made up in several pieces because of low basement ceiling heights. Additional pieces are fastened on as the riser is pushed up into place.

Labor Costs

Estimating labor costs on these jobs is particularly difficult. A unit cost per radiator determined from experience from past work is usually used. Figures included illustrate one method as worked out by a Chicago estimator, and are not necessarily applicable to all conditions in all localities.

Unit costs tabulated are based on a price per *floor* radiator, which includes installing the average heating system, such as setting up the boiler, concealing risers, etc. Extras should be added to this total.

Floor	Cost per Hot Water Radiator	Cost per Steam one-pipe Radiator
First	$14.00	$11.50
Second	19.50	17.50
Third	21.50	21.00

When a job exceeds eight radiators deduct $1 per radiator; if it exceeds 20 radiators, deduct $1.50 per radiator; deduct $3 per radiator if risers are to be exposed; for wall radiators add $3 per radiator; for ceiling radiators add $5 per radiator.

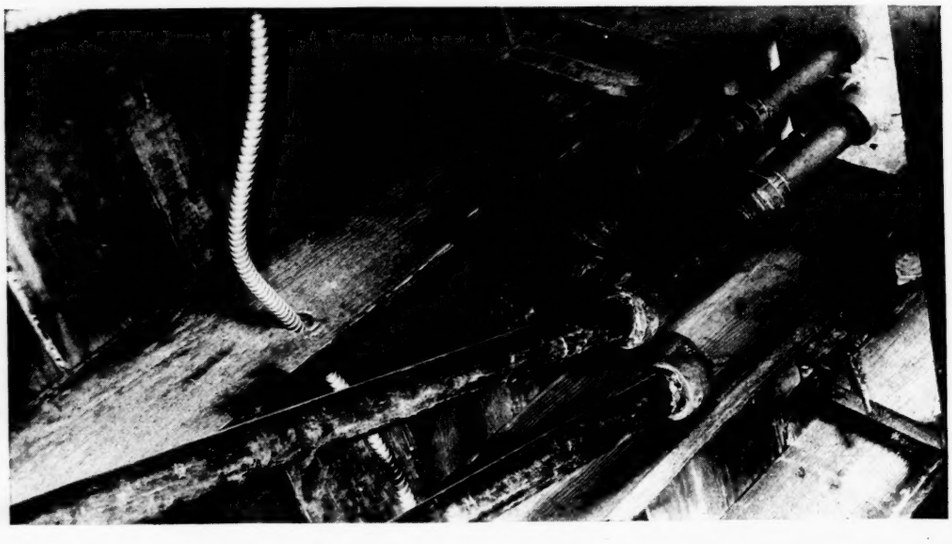

Fig. 5. When the risers are up and attached to the radiators they are then connected to the mains with railroad unions, as shown.

Are Winters Getting Warmer?

In which the authors conclude, after a study of Boston winter temperatures, that the trend in that city is toward milder heating seasons.

By R. M. NEE† and D. S. BOYDEN‡

BELIEVE it or not, Boston is getting warmer every year. United States Weather Bureau records prove it. They show that downtown Boston is not as cold now as 40, 50, and 60 years ago.

Outdoor temperatures during the heating season are of vital importance in our work. We are affected by the average temperature during the heating season and also by the minimum temperature reached in any season. The seasonal average affects the amount of steam used for building heating and determines our revenue from this source. The minimum temperature fixes the peak demand, and thus governs the size of generating and distributing system.

Because of the importance of these items we realize the necessity of following temperature trends. As a result, one of our associates, E. W. Gray, made a study of Boston temperatures from 1871 up to date. We believe that the methods used and the findings will be of interest to others.

Data for this study were taken from the Weather Bureau records at Boston. We tabulated the absolute minimum temperatures (yearly) and average heating season mean temperatures and plotted curves. The degree days for the past 20 years were figured from the daily records. Fig. 1 shows the minimum yearly temperatures; Fig. 2 shows the average temperatures, and Fig. 3 shows the annual degree day figures. Trend lines are drawn in Figs. 2 and 3.

Minimum Temperature

The records of minimum temperatures go back as far as 1873. Fig. 1 show how irregular these have been. The irregularity makes it practically impossible to foretell minimum temperatures of the future. It is possible, though, to pick a conservative base temperature.

The lowest minimum temperature on record is –14°, recorded December 30, 1917. Since that date the lowest temperature was –10° in 1918. Previous to December, 1917, the lowest temperatures recorded were –11° in 1914, 1896, and 1875; –10° in 1886 and 1884, and –13° in 1883.

Considering these figures, a base of –10° would seem to be safe for estimating peak loads and installing plant capacity. Although there are six points recorded below –10°, only three of these points are appreciably lower, the other three having been –11°. Should the temperature go lower than –10°, the unexpected overload could probably be taken care of for the short duration of time it would exist. It does not seem justifiable to carry capacity in the heating plant and distribution system with the corresponding investment, to guard against the additional demand that would be created when the temperature dropped below –10°.

Previous to the present study our practice was to base our predictions of peak hour demands on –5°, which, in view of the above minimum, does not appear to be low enough.

The importance of a careful selection can be appreciated when we note that for Boston conditions using –10° for a base temperature for peak load predictions instead of –14°, the saving in investment would be approximately $180,000 where $6,000,000 was invested equally between the plant and distribution system.

Mean Temperature

Referring to Fig. 2, the trend curve of the seasonal mean temperatures from 1871 to 1931 shows a gradual straight line increase. The increase is approximately

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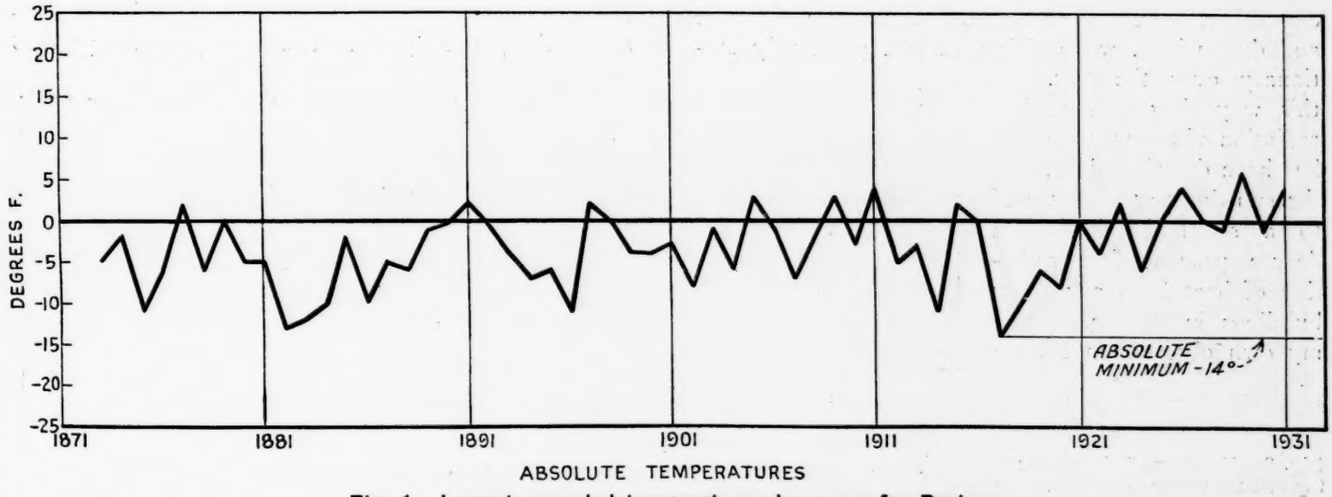


Fig. 1. Lowest recorded temperatures by years for Boston

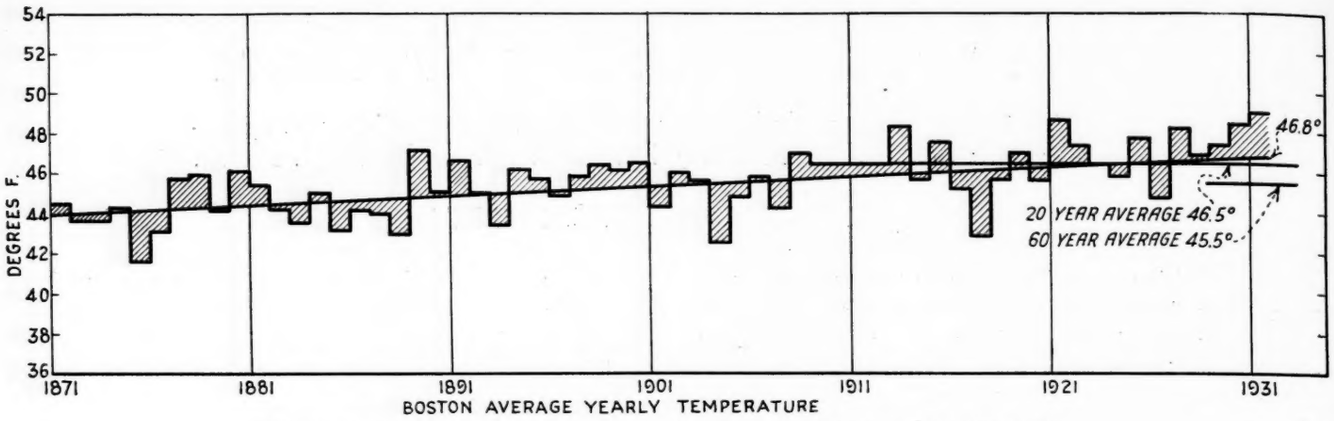


Fig. 2. Average yearly temperatures by years for Boston, with trend line

0.6° every 10 years, or a total rise of 3.5° between 1871 and 1931. The present normal temperature used (45.5°) is the average of the past 60 years. This normal is 1° below the normal of the past 20 years and 1.3° below the trend point for 1931. Owing to this upward trend and the uncertainty as to when it will stop, the trend point seems to be the logical normal temperature to use.

One difficulty in interpreting the trends is that of not knowing in advance when the trend may change. Weather authorities have called attention to this. While they are not in entire agreement it is interesting to include the observations of one who is familiar with New England conditions. E. B. Rideout, formerly an observer at the Boston office of the Weather Bureau, states his theory of this phenomenon thus: "Heat radiation from buildings under certain conditions has shown an effect on the temperature average in Boston. This would also apply to other large northern cities. In looking over the records recently, I found that the averages have actually shown an upward tendency. This is particularly noticeable in the summer as well as winter averages.

"During the late spring, especially during what we may call the between seasons of artificial and natural heating requirements, I found that there was practically no change in that average, covering a period of 60 years. The upward tendency in the temperatures during the winter and summer season of recent years is due to artificial conditions. For instance, on a calm, clear night there is more or less accumulation of smoke and dust which, when rising, remain practically stationary over the city. In this way they prevent free radiation of the warmth that has been distributed here by the sun during the day, and to a small fraction of a degree prevent free radiation of heat from our many buildings in Boston. From my own observation I have noticed in my nightly drives from Boston to my home in the suburbs, that there will be a variation of as much as 8° to 10°. Of course, this variation does not occur when there is a circulation of air.

"Covering a long period of time, the length of a normal heating season would naturally coincide with our climatic cycles. As far as the immediate future is concerned, I feel confident that because our winters have been warm recently, the normal trend of the heating season will be downward."

Be this as it may, Fig. 2 does show that the maximum variation below the trend line is 3.2° in 1917 and 2.4° above the trend line in 1913, the average variation being from 1° to 1.5° above or below the trend line, whereas the actual temperature varies from the present normal (45.5°) by at least 2° above the normal with a maximum variation of 3.5° above, and in only three cases does the mean temperature go below normal during the past 23 years.

Degree Days

While mean temperatures tell the story of progressively warmer winters, the heating engineer in recent years has come to use degree day figures in his estimating. It seems best for his purposes to translate the story into these terms.

The curve of degree days (Fig. 3), being based on mean temperatures, shows the same characteristics as the mean temperature curve with a general decrease in the number of degree days. The number in common use as normal at Boston at present (6045) is the average of the past 50 years. The average of the past 20

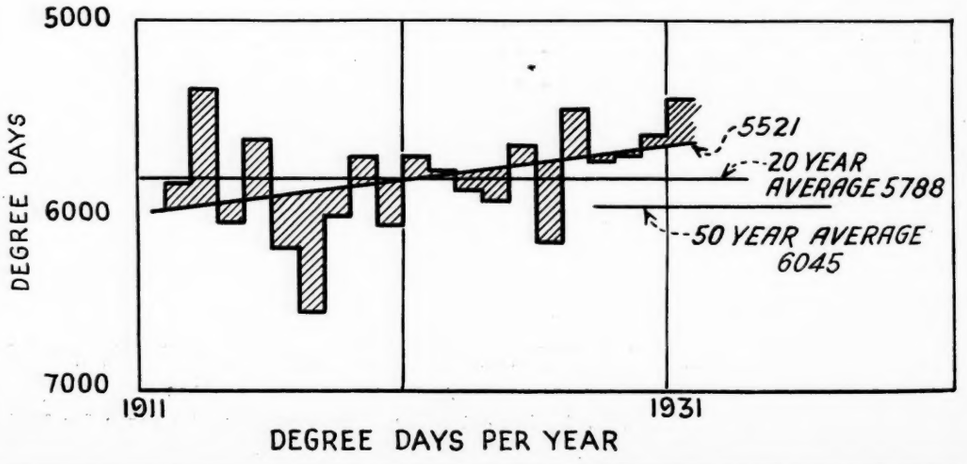


Fig. 3. Number of degree-days for Boston for the past 20 years, showing trend line.

years is 5788, and the trend point is 5520 degree days. In order to bring the average of 25 years up to the 50-year normal (6045) the next five years would have to average 7073 degree days per year. This figure is higher than any on record for the city of Boston. Although it is possible that we might have such a year, it is improbable that there will be five such years in a row. Should we have normal weather (6045 degree days) for the next five years, it would give us a 25-year average of 5839 degree days, only 51 degree days per year above the present 20-year average. As the curve of degree days follows the average mean temperature curve, the same conclusions may be drawn for both curves, namely that the trend points should be used for estimates instead of a straight average.

In view of this study we believe that 5520 should be used as the number of degree days per normal heating season for Boston instead of the 6045 ordinarily used. This would amount to a reduction of about 9%.

The study also shows that 46.8° appears to be a better normal heating season temperature than the 45.5° normal used by the Weather Bureau.

Results of our study were not wholly expected, and because of this it seems quite possible that similar studies in other cities, especially in the downtown districts, may be very much worthwhile.

Training Pipe Welders

IN the building trades there are certain pitfalls to training programs organized and conducted under private auspices. We have had in our industry a few training programs conducted by unions which have been productive of very good results. On the other hand, we have had several programs which have been started, and because of lack of proper organization and financing were dropped without any results. In fact, in a few cases unions have exhausted all their budget allowance in the purchase of equipment and have had no funds left for the purchase of welding rod, gases, and other supplies, and for paying an instructor.

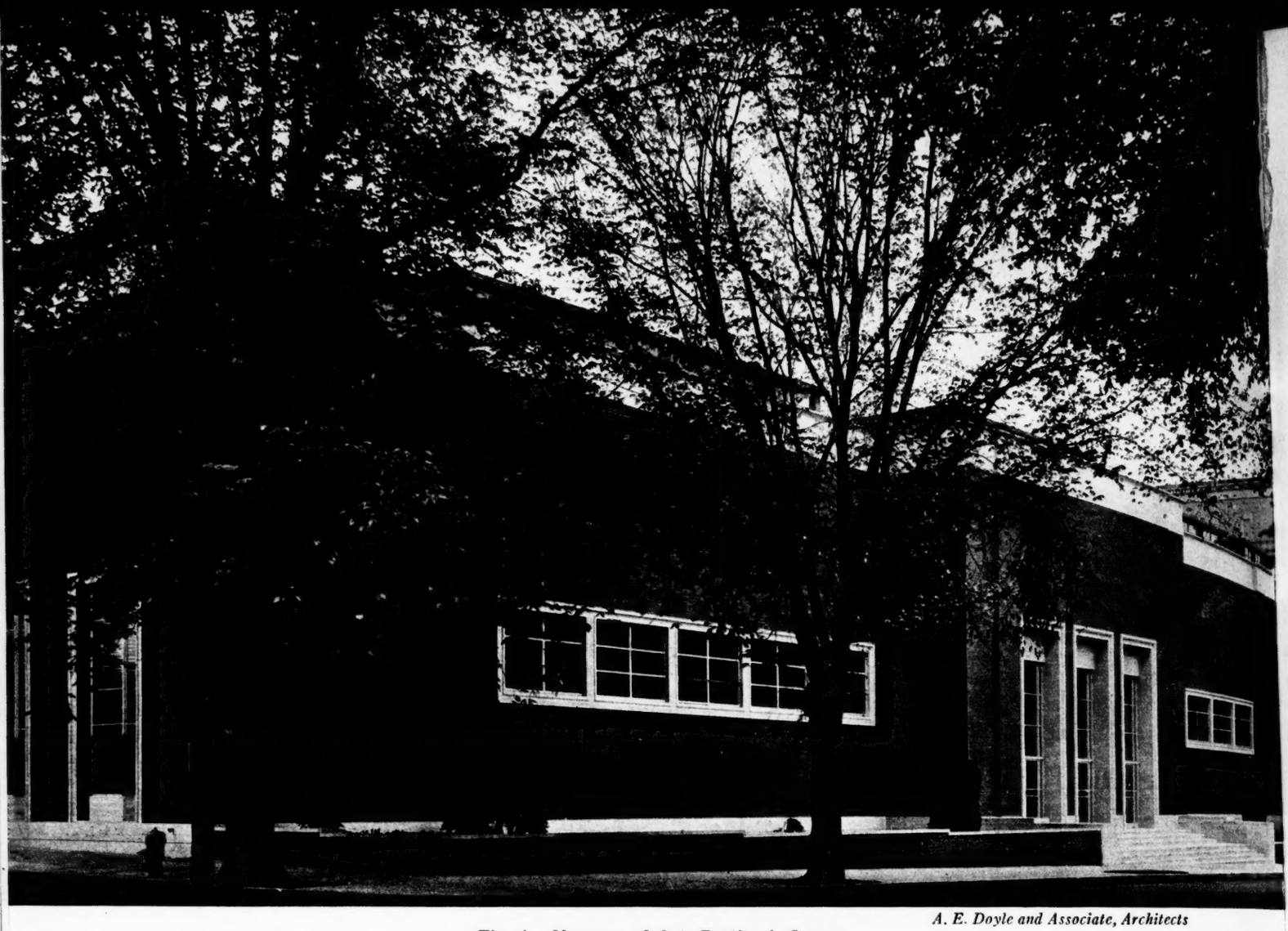
In the case of the training program organized under the auspices of an employers' association and a group of journeymen, failure usually results because of lack of proper organization and administrative machinery, and because of the lack of any plan to promote attendance. Such a program is usually set up in a haphazard manner without any specific course of training laid out, without any set period of training to complete, and usually without any provision for organized instruction. Such training programs do more harm than good. Without a definite, specific course of training and proper instructional and supervisory provision being made, the steamfitter or other mechanic may establish welding habits detrimental to him as a skilled mechanic and to the trade he represents.

In the case of the private school (and let it be definitely understood here, too, that what I have to say is not a blanket condemnation of all private schools) frequently the training project degenerates into an outright fraud. Some know of cases where private enterprises have been set up, wild and impossible promises made to prospective learners, monies collected for tuition, and then "stakes pulled up" and moved to another town to do the same thing. This, of course, is unfortunate because there are some private schools in welding, as in other lines, that do a very good training job.

Now to the crux of the whole situation. Frankly, it is our belief that you and the salesmen who represent you are largely responsible for the chaotic situation in which we find ourselves with reference to the organization and administration of these training programs. There is lack of uniformity in promotional effort. There is great need for a well planned, well organized, uniform program which your group as well as our own and other allied interests can get behind and push.

Here is what is happening. Frequently, we go into a community where the salesman of one concern has approached organized labor with a proposal for a training program for their members, and in several cases has sold them equipment for such a training program. In the same city the salesman of another firm, selling either apparatus or supplies, or both, has approached a group of employers with a like proposal. Still another salesman has approached the local vocational school authorities. While all three are aiming at the same ultimate goal, they have approached different groups; they are hindering each other's efforts; and they are making impossible the attainment of the ultimate goal in which all of us are interested, namely, the establishment of a definite organized training program which will have the support and cooperation of every interest. Why could not those three salesmen have promoted a uniform program which involved the working together of the three interests which they approached and in this way have eliminated the chaos which existed, which in many cases still exists, and which often makes it difficult, or impossible, to establish a training program?

Are we interested in the sale of so much equipment and supplies, or is our major interest the production of mechanics who are skilled in welding? I believe you will agree with me that fundamentally our major interest is the latter. I believe you will also agree with me that you will sell more equipment and more supplies in proportion, as we have an adequate number of skilled mechanics who can use that equipment and those supplies. In fact, some of you have said to me that the greatest hindrance to the more rapid development of welding in a number of industries is the lack of mechanics who can do welding. It is important, then, and perhaps it is to the best advantage of each individual company, to see these problems of the proper organization and administration of training programs from the standpoint of the industry, rather than from the standpoint of an individual firm or company. — *From an address by Dr. S. Lewis Land, Heating and Piping Contractors National Association, before the 33rd annual convention of the International Acetylene Association.*



A. E. Doyle and Associate, Architects

Fig. 1. Museum of Art, Portland, Oregon

Heating and Ventilating Portland's New Museum of Art

By W. E. KEMERY, JR.†

THE recently completed Museum of Art, Portland, Ore., in addition to being the first building of its kind in this country employing monitor-type windows for lighting of galleries, contains a heating and ventilating plant embodying several interesting features.

Due to limited funds available both the first cost and the operating cost of the plant were of primary importance. For this reason the use of refrigeration necessary for complete humidity control was abandoned and the problem became one of maintaining the relative humidity within reasonable limits without it and making the operation of the plant as nearly automatic as possible so as to not require the services of a full-time engineer.

The entire building is heated by means of an indirect central fan system with the exception of thermostatically-controlled convection-type heaters located in stair halls having large glass exposure. Steam is supplied from the mains of the local central heating company at 30 lb. pressure and reduced to approximately 5 lb.

†Mechanical Engineer, A. E. Doyle and Associate, Architects, Portland, Ore.

Recirculated Air Used for Tempering

As shown in the accompanying diagram, Fig. 3, fresh air is admitted through dampers located below grade at the north side of building entrance, and the surplus return air is exhausted through gravity-operated aluminum louvers at the south side of the entrance. The fresh air is tempered in mixing chamber No. 1 to approximately 40° by means of recirculated air admitted through dampers B. These dampers operate in conjunction with fresh air dampers and recirculating dampers D and are controlled by intermediate-acting thermostat T-1 located just ahead of air washer.

Return Condensate Used for Heating Spray Water

Due to the very small hot water load in the building the return condensate after being metered is discharged directly into the air washer tank. Under average heating season conditions there is sufficient heat from this source to offset 50% to 75% of the wet bulb drop through the washer and sufficient water to take care of the make-up requirements. Thermostat T-2, located behind the air washer, is the conventional reverse-acting dewpoint thermostat operating the mixing valve supplying hot water to sprays through a closed heater. This is set normally at 48° except when it may become necessary to reduce it somewhat in extremely cold weather to prevent the formation of condensation on windows. The two-point thermostat T-3 controls: (1) the three-way valve in line from condensation pump by-passing condensate to sewer when temperature exceeds 55°, and (2) the direct-acting valve cutting out one bank of sprays if temperature continues to rise, thereby ceasing to saturate the air and, consequently, reducing its dewpoint. After mixing with the recirculated air in mixing chamber No. 2 the air is then passed through an automatic multi-panel filter and thence through the supply fan to the heating coils. Filtering of the air at this point rather than at the outside air intake was decided upon because it was considered highly desirable to refilter the recirculated air, and in this poistion the filter is relieved of a large part of its load by the air washer.

Plenum Temperature Automatically Adjusted to Heating Load

The heating coils consist of four rows of copper fin coils controlled by the four-point thermostat T-5. This thermostat is inserted in a 2-in. tube connecting the cool and warm-air sections of the plenum and effectively adjusts the temperature of the warm-air section to the heating load as the pressure varies in the two chambers due to the demand upon them.

City Water Used for Summer Cooling

Thermostat T-4 located at discharge of exhaust fan is a two-point positive-acting thermostat designed to give relief from over-heating due to the heavy lighting load in the galleries or sunlight on the large glass exposures. When the temperature rises approximately 3° above normal at this point the thermostat first closes recirculating damper D through a relay, thereby supplying all fresh air to the building. If the temperature continues to rise, as it might on an extremely hot day, city water at approximately 58° is supplied directly to both banks of sprays as the air washer pump discharges directly to the sewer. At the same time recirculating dampers C in the mixing chamber No. 1 open, recirculating the cooler air from the building.

Distribution in Galleries

Supply and exhaust openings in the galleries are both located in the same wall which is furred out to accommodate the ducts. The exposure offered by the monitor windows is a severe one and the opinion was expressed by several authorities that cold down-drafts could not be avoided unless glass ceiling lights were installed below the monitors or direct radiation was placed in the monitors. As neither scheme was adapted to the lighting or the architectural effect desired the supply ducts were installed as originally planned with deflector-type dampers. These dampers were set so as to discharge the air through the lower part of the grilles at

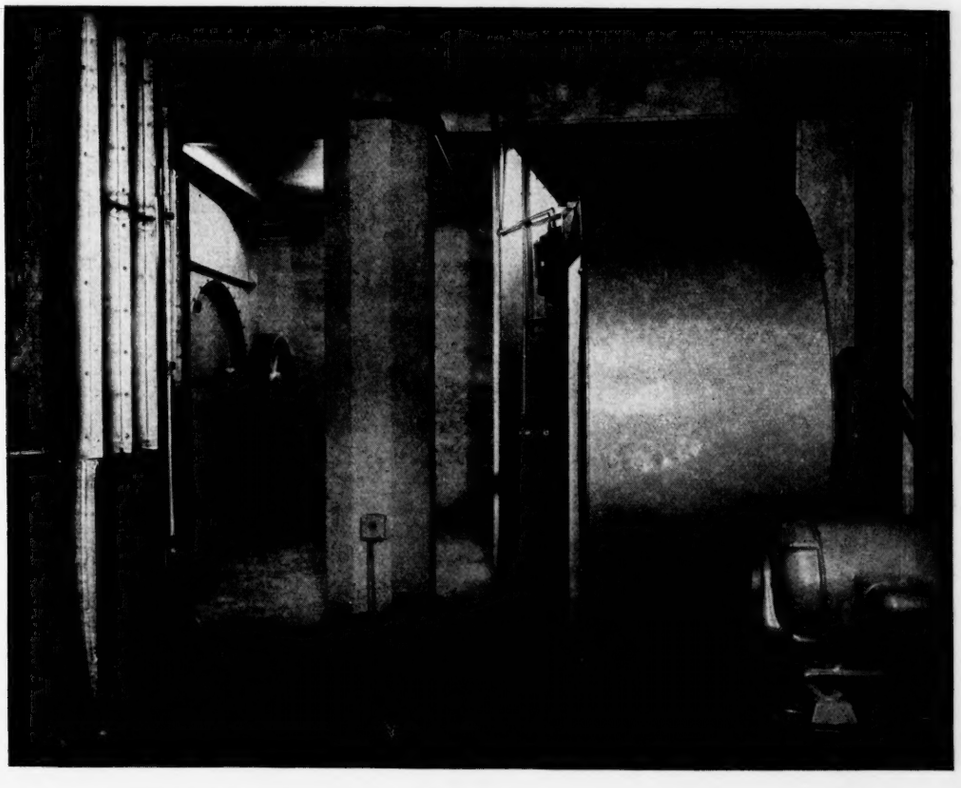


Fig. 2. Supply and exhaust fans in basement

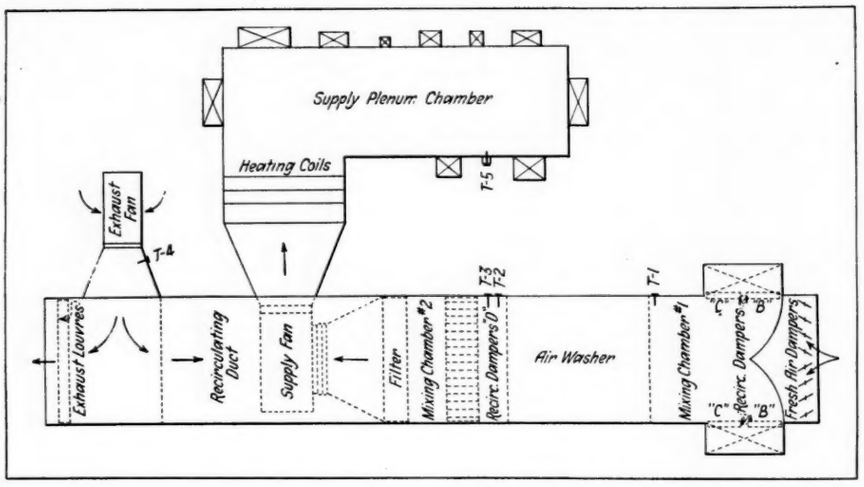


Fig. 3. Plan showing arrangement of conditioning equipment

a velocity of approximately 500 f.p.m., at an angle slightly inclined above the horizontal, with the result that during a recent severe cold spell no cold drafts were experienced from this source. All galleries are separately controlled by means of duct-type thermostats located in exhaust ducts behind removable panels in the wainscot as the usual wall-type room thermostats had proved a constant source of trouble in the old building.

Plenum Insulation Serves as Sound Absorber

The plenum chambers are completely lined with ½ in. board insulation bolted to the walls and ceiling and the joints stripped with 2 in. x ⅛ in. metal strips fastened through the housing. This lining serves the double purpose of providing a sound absorbing medium between the fans and galleries as well as heat insulation, leaving the smooth metal surface of the housing exposed on the outside. All heat ducts within the mechanical room are insulated with 3-ply asbestos blocks wired on and covered with asbestos cement and canvas jacket, with the result that the build-up of the temperature of the air passing through this room (which also serves as an exhaust plenum) is very low. All fans, motors, and pumps are isolated on machinery cork foundations and fans are connected by means of multiple belt drives resulting in a quiet operating plant, essential in this type of building.

Climatic Conditions and Tests

Portland's normal winter temperature is 40.9° with only four days per year when the temperature remains below freezing for 24 hr. The normal summer temperature is equally mild being 65.3° with only six days per year when the temperature exceeds 90°. The normal relative humidity is 76% in winter and 50% in summer, although the extremely hot weather is accompanied by very low humidities.

The accompanying chart taken during actual operating conditions shows the satisfactory manner in which

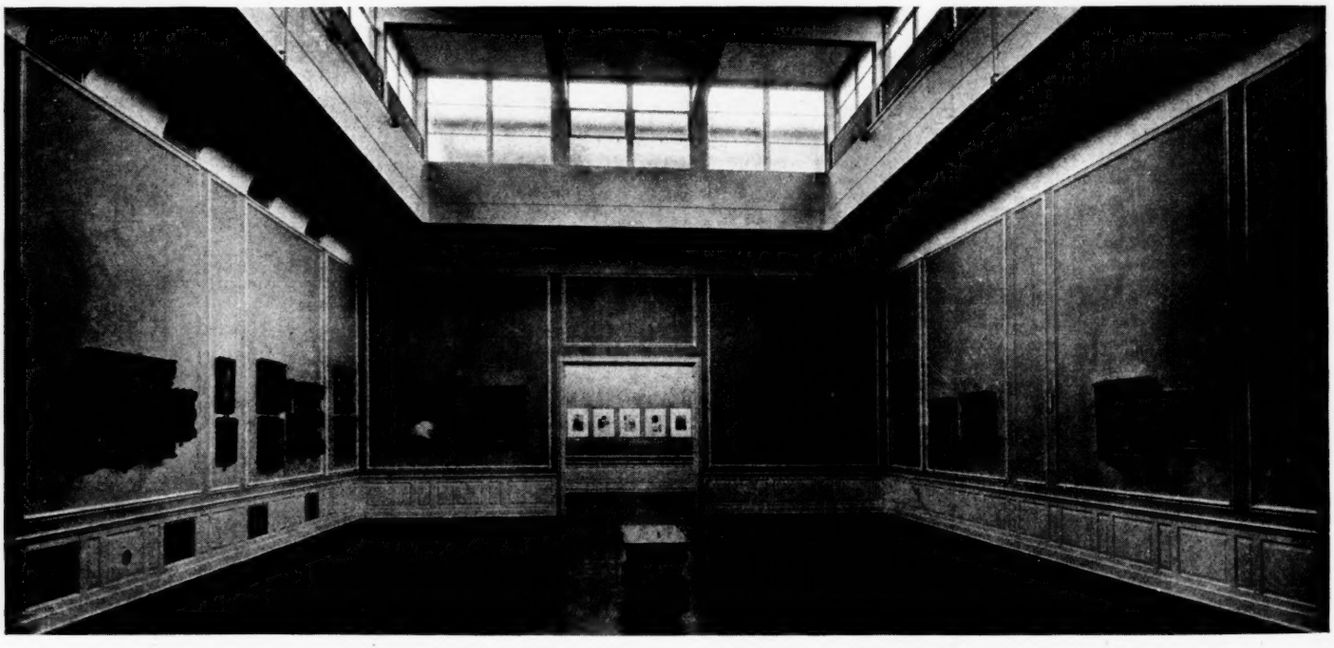


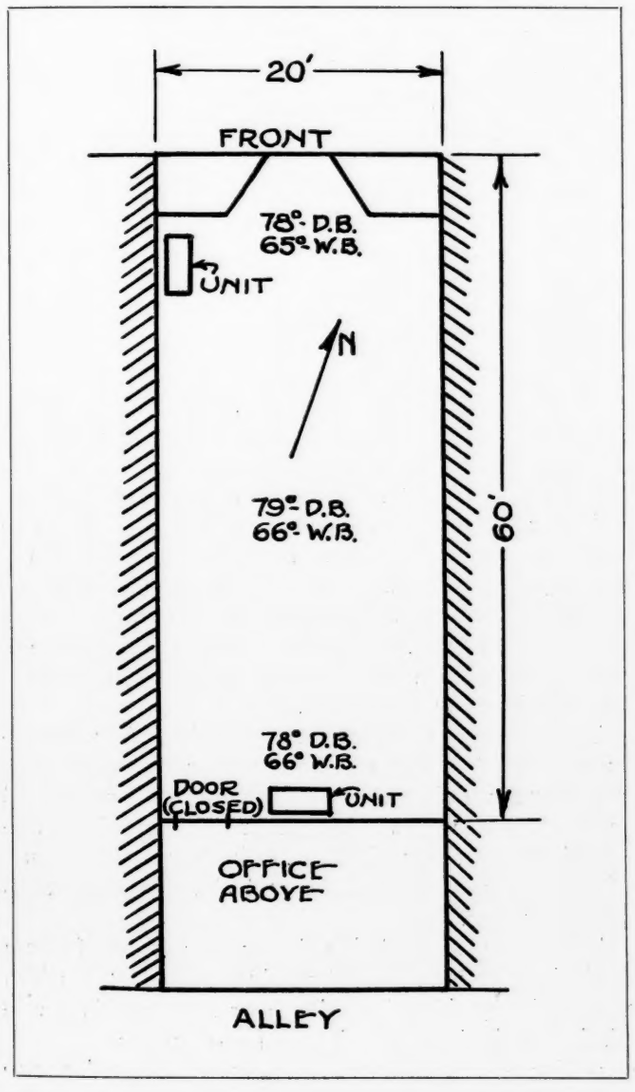
Fig. 4. Interior view of gallery showing supply and exhaust ducts in wall at left. Note monitor windows

Location / Time	Outside Air			M.C.#1	2nd bk.	Mix. Chamber #2			Plenum		Return Air			Pic. Stor. Room			Grad. Fl. Hall			1-B & 1-C			1st Fl. Hall			1-A & Lib			2-E & 2-D			2-C			2-A & 2-B		
	D.B.	W.B.	D.P.	D.B.	Sprays	D.B.	W.B.	D.P.	W. Air	Temp. A.	D.B.	W.B.	D.P.	D.B.	W.B.	R.H.	D.B.	W.B.	R.H.	D.B.	W.B.	R.H.	D.B.	W.B.	R.H.	D.B.	W.B.	R.H.	D.B.	W.B.	R.H.	D.B.	W.B.	R.H.	D.B.	W.B.	R.H.
9 30	39.5	38.5	37.0	42	on	45	45	45	98	60	70	56.5	46	66.0	54.5	47%	67.0	55.0	46%	68.0	55.0	43%	68.5	55.5	43%	68.5	55.5	43%	69.0	56.0	44%	69.0	56.0	44%	68.5	56.0	46%
10.30	41.0	40.0	38.5	42	on	44.5	44.5	44.5	99	60	70	56.0	45	66.5	55.0	48	67.5	55.0	45	68.5	56.0	46	69.0	55.5	42	69.0	55.5	42	68.5	55.5	43	67.5	55.0	45	69.0	55.5	42
11 30	43.0	41.0	39.0	43	on	45	45	45	100	60	70	56.5	46	66.0	55.0	50	68.0	55.5	45	69.0	56.0	44	69.0	56.0	44	68.0	55.5	45	69.0	56.0	44	68.5	55.5	43	68.0	55.5	45
12 30	43.0	41.0	39.0	43	on	45	45	45	102	60	70	56	45	67.0	55.0	46	67.5	55.0	45	68.0	55.5	45	68.0	55.5	45	68.0	55.5	45	70.0	56.5	42	67.0	55.5	48	70.0	56.5	42
1 30	44.0	41.5	39.0	44	on	45	45	45	98	60	70	56	45	66.5	55.5	50	67.5	55.5	47	68.0	55.5	45	68.5	56.0	46	69.5	56.0	42	70.5	56.5	41	69.0	56.0	44	68.0	55.5	45
2 30	44.0	41.5	39.0	44	on	46	46	46	100	60	70	56.5	46	67.0	56.0	50	68.0	56.0	47	68.0	56.0	47	68.0	56.0	47	68.5	56.0	46	70.5	57.0	42	67.5	55.5	47	70.0	56.5	42
Averages														66.6		48.5	67.6		45.8	68.3		45	68.5		44.5	68.6		43.8	69.6		42.7	68.2		45.2	69.0		43.7
Max. Variation														1°		4%	1°		2%	1°		4%	1°		5%	1.5°		4%	2°		3%	2°		5%	2°		4%

Fig. 5. Temperatures and humidities observed at various locations in museum

the temperature and relative humidity are controlled during cool weather. Although no test data for summer operation are available at this time, it is expected that the range of variation between summer and winter operation will be within the limits assumed in the design.

Air Conditioning for Small Store Costs 16 Cents per Hour to Operate



Plan showing location of cooling units in small store

THE installation of two air conditioners in a men's furnishing shop in a mid-western city has resulted in an increase in business during the hot summer months and costs the owner but 16 cents per hour to operate. This includes the cost of the circulating water.

Two unit conditioners maintain an inside temperature of 80° and a 50% relative humidity when the outside temperature is 95° and the relative humidity high. High water temperatures in the city mains during the summer months necessitated the use of a 3-ton refrigerating machine to obtain the 45° water for the cooling elements. The refrigeration apparatus is located in an out-of-the-way corner of the basement and requires no attendant. The compressor and cooling coils are in the background, the liquid refrigerant passing from the coils to the heat exchangers in the foreground where the refrigerant is expanded, absorbing heat from the water. The chilled water is forced through the units on the floor above by the motor-driven pump mounted on the exchanger. The cooling water for the units is circulated in a closed system, requiring practically no make-up.

Each unit circulates 400 c.f.m. of cooled air at maximum speed, there being three speeds available. A special drip pan connected to a drain is provided to collect all water condensed out of the air as it is cooled, no moisture showing on casing or discharge grilles.

The conditioners are placed in the store as shown on the floor plan in the sketch. This arrangement of the units gives an excellent distribution of the cooled air throughout the room, as can be seen from the temperatures marked on the diagram. The readings were taken during a recent hot spell when a test was run on the equipment. With an outside temperature of 92°, the inside dry bulb temperature remained fairly constant at 78°, while the relative humidity varied but 3% throughout the length of the store.

—James J. Murray.

Steam Service Control Reduces Over- and Under-Heating in Department Store

By P. A. HYDE†

EVER since the Ohio Edison's heating plant has served the M. O'Neil department store, Akron, with steam for all its heating requirements, various types of steam service control were considered for this particular building. The owners finally decided upon a type of control that would meet their needs. Consequently, a very complete survey was made of the entire heating system, and it was finally decided to zone the building in two separate and distinct parts. It so happened that this could quite readily be done by the installation of one 10-in. and one 12-in. motor-operated valve located on the sixth floor of the building. The 12-in. valve controls all the merchandising portion of the building and divides the heating system almost in two in that manner. The other valve controls the garage and warehouse portion of the building.

Due to the fact that there is considerable cast-iron indirect radiation in the building along with the regular column type, radiation figures are omitted. To give a general idea of the size of the building, the volume is approximately 7,000,000 cu. ft. All the space in the building, including basements and sub-basements is heated in some manner, so that whatever radiation there is in the building is doing its share towards bringing it up to temperature. The diagram in Fig. 1 shows the layout of the steam supply and location of the 10-in. and 12-in. valves.

The temperature required in the store is 70°. The upper two floors of the warehouse section should be 70°, the first floor 60°, and the main and basement floors, used as a garage, are held between 40° and 50° to prevent freezing. The radiators are supplied by downfeed risers from mains on the sixth floor of the store and the third floor of the warehouse. Steam is supplied to these mains by a 16-in. riser from the pressure reducing valve in the sub-basement.

†Superintendent of Steam Sales, Ohio Edison Company, Akron Division.

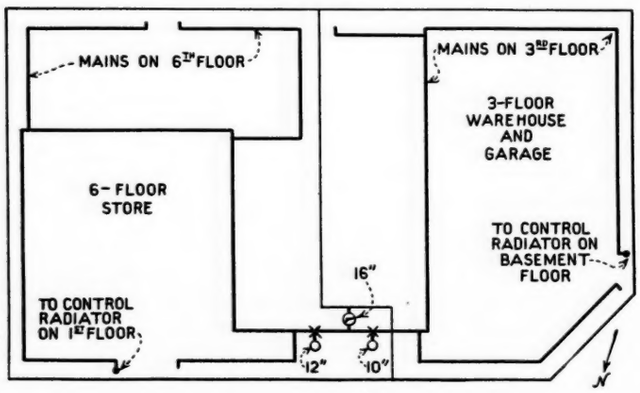


Fig. 1. Layout of steam supply and motor-operated valves

In the past, without steam service control, considerable differences in temperature were noticed in all parts of the building, and quite naturally most of the overheating complained of was on the top floors of the merchandising portion of the building, and probably caused by the stack effect of the elevators.

With the old layout it was impossible to shut off the merchandising portion of the building without considerable inconvenience and still leave the steam on the garage and warehouse, or vice versa. This arrangement naturally caused considerable loss of steam and also overheating.

Fig. 4 shows the variation in steam consumption before the system was changed. The chart shows the steam used per degree-day, and illustrates the wide fluctuations prevailing before the control was installed. The wide variation in these figures, from 4,420 lb. to 1,340 lb. per degree-day, indicates that the heating system was not properly controlled, for under proper control the number of pounds steam per degree-day should be practically constant. Consequently, Fig. 4 indicates that the building was overheated part of the time and underheated at other times.

The engineer at the store furnished additional information of value. He had found that in the afternoon the upper floors of the building would become unbearably hot, even in cold weather with the upper floor radiators turned off, if he supplied sufficient steam to keep the first floor at 70°. Due to this condition, the clerks on the upper floors would open windows, letting out the excess heat. The engineer also noticed that calls for heat were received when the steam was shut off for a time, even though the temperature in the store was considerably above 70°.

The problem of maintaining comfortable temperatures on all floors of the store section was equally as important as saving steam. Two factors to be recognized in this respect were the heat from large crowds on certain days and the stack effect, quite important because of the many stair, escalator and elevator connections between floors.

The survey showed that there was a waste of steam in the heating system and brought out the factors which were to be considered in adapting a system of heat regulation to the building. These factors were:

a. Zoning—At least two zones were indicated, one to take care of the warehouse and garage, the other zone taking in the merchandising section.

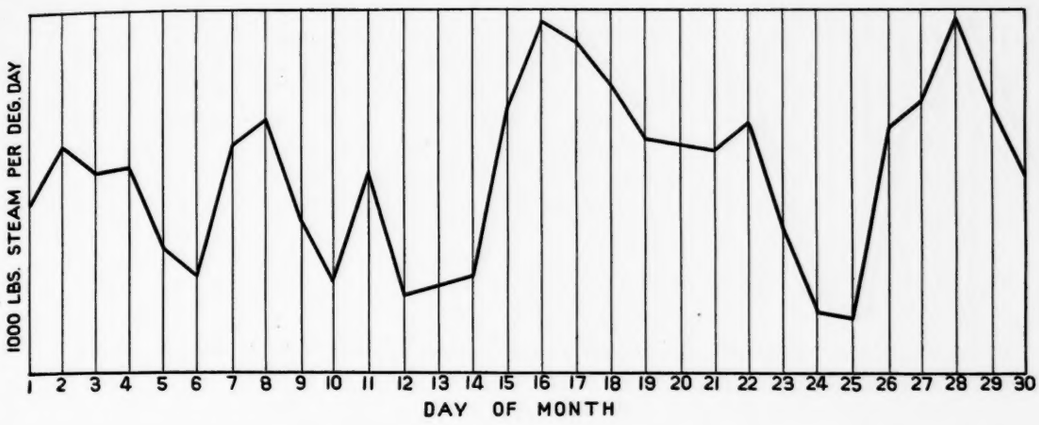


Fig. 2. The quantity of steam used per degree day, December, 1931, fluctuated greatly before the control was installed.

b. Elimination of "building up" high temperatures in the upper floors of the store.
c. Operation independent of clerks' actions.
d. Protection against high temperature due to large crowds in store.
e. Elimination of complaints caused by cold radiators.
f. Protection against freezing at night, eliminating expense of keeping steam on all night.
g. Maintenance of a constant steam consumption per degree-day.
h. Low initial cost (an important factor).

Experience with the type of steam service control installed indicates that it can be adapted to take care of all the factors mentioned above.

Basically, the system controls the steam admitted to the heating system by the combined action of an outside and two inside thermostatic bulbs, so that only sufficient steam is used to heat the building comfortably for the actual outdoor temperature. The two inside bulbs are attached to the radiator farthest from the supply and through the action of the control, turn the steam supply on and off periodically to maintain the average radiator temperature corresponding to the outdoor temperature. With the steam entering the mains in short frequent bursts, there is a tendency partially to fill all the radiators rather than fill completely those closest to the service with consequent lack of steam at the ends of the mains. "Overshooting" and "lag" of inside temperatures are eliminated since the radiator temperature rather than air temperature is used for control. Thus, the radiators are sensibly warm at all times with the heat increasing as the outside temperature drops.

The control in the merchandising portion was attached to the radiator on the bottom of the last riser on the longest main, with the outdoor bulb on the north wall of the building. Similarly, the system in the warehouse section was controlled from the last radiator with the outside bulb on the west wall. Sun shields were used to protect the outside bulbs from the direct rays of the sun.

A thermostat was installed on the first floor of the store and connected as a limit control to shut off the steam when the temperature rose above 72°. This took care of the extra heat supplied by crowds of people at sales and rush hours, preventing the building up of temperature which had formerly overheated the upper floors. Another thermostat was installed on the first floor of this zone and set at 60° for night control. The system was equipped with two mercury tubes, one for daytime control and the other for morning heating-up control.

The electrical connections from these controls were brought to a control panel in the engineer's office and thence to the motor valve on the sixth floor. An electric time switch in the control panel automatically switched the steam control. This clock was set to start the morning heating-up period at 6:30 a.m., switching to daytime control at 9 a.m., and switching the control to night thermostat at 5:30 p.m. A week-end shut-off held the control on night thermostat over Sundays. A manual switch allowed the engineer to change control at any time to:

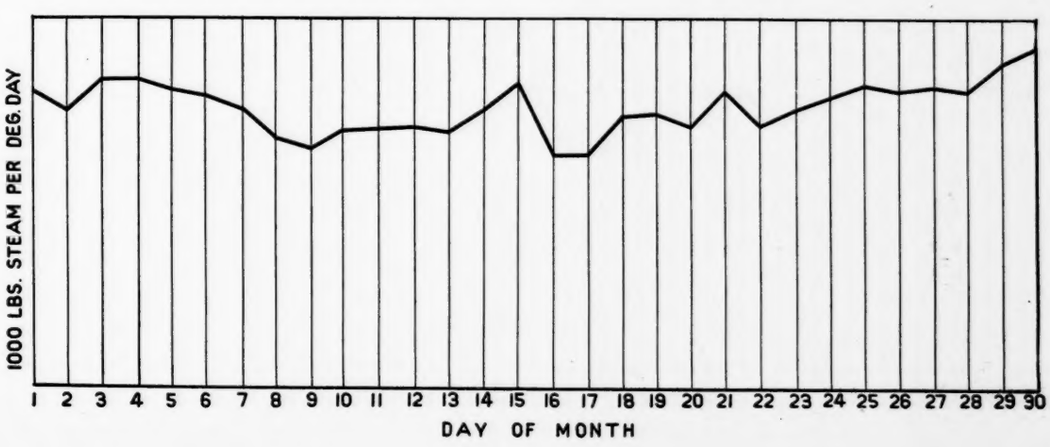


Fig. 3. Steam consumption per degree day for December, 1932, after the control was added. The peaks have been largely ironed out.

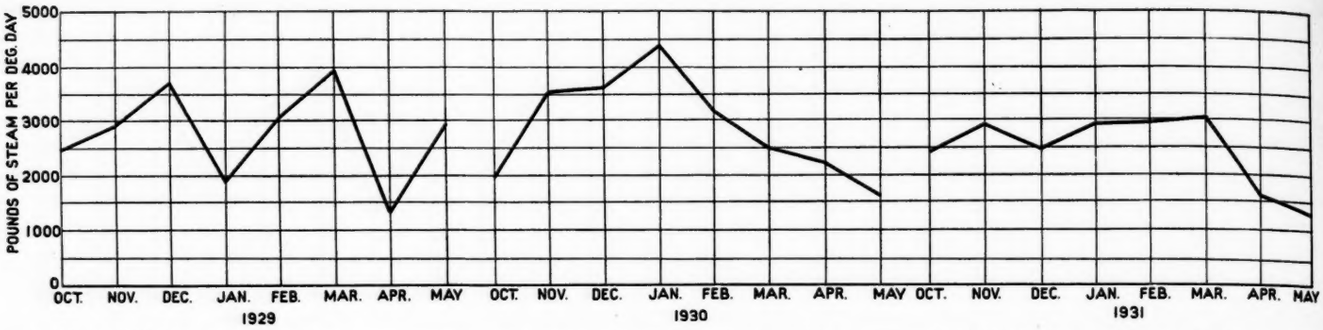


Fig. 4. Variation in the steam consumption per degree day for three heating seasons prior to the addition of the control

1. Automatic
2. High control
3. Low control
4. Valve open
5. Valve closed

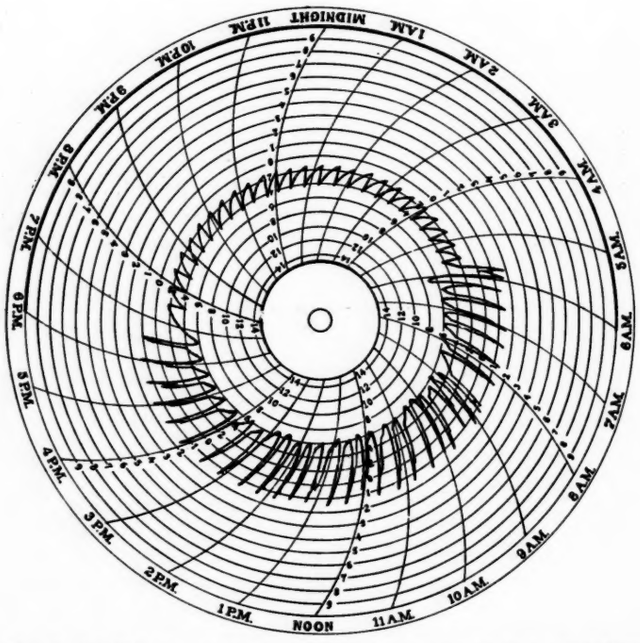
The warehouse zone control was similar except that the two thermostats were installed on the top floor. This location was chosen since there were no connections between floors, eliminating stack effect and the large roof exposure made the top floor the first place to cool at night.

The installation of this equipment was finished on October 20, 1932, and has been controlling the steam consumption since that date. Operation in the months of November and December shows that the desired results have been attained.

A recording pressure gauge was installed in order that a record of performance could be obtained. A chart from this gauge (Fig. 5) shows the periods of operation and the increasing frequency of operation as the outside temperature drops. With the outside thermometer at 49°, the steam is turned on about twice an hour, and at 25°, about five times per hour. The time switch turns the control to high control at 5:30 p.m. and to low control at 8 a.m. Under high control steam was turned on about three times per hour on the warm day and six times per hour on the cold day. At 6:30 p.m. the control was automatically switched to the night thermostat which did not call for heat all night. The short jogs in the pressure line are due to the vacuum pumps cutting in and out during the night.

Recording thermometers were placed in various parts of the store and showed remarkably constant temperatures. The building up of temperature was cut down until it was about 3° from 9 a.m. to 6 p.m. Fig. 6 is the chart from the third floor of the store, showing temperatures of from 70° to 74° each day, although the temperature dropped more than 20° between Tuesday the 6th and Thursday, the 8th. Fig. 7 is a chart from the recording thermometer in the warehouse for the period Tuesday the 6th to Thursday the 8th, showing practically constant temperature on all days.

The daily steam consumption per degree-day was plotted for December, 1931, and for December, 1932—before and after the installation of heat regulation, and shown in Figs. 2 and 3. These charts show how the control evened out the steam consumption to fit the weather. There are still irregularities in the pounds per degree-day figure due to the fact that the building was divided into only two zones, with three different



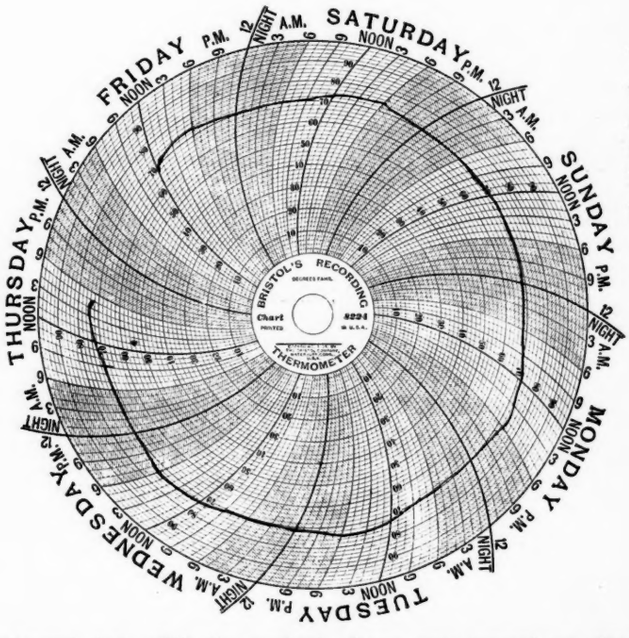


Fig. 5 (Left) A recording pressure gauge in the warehouse showed that, with the control, steam was turned on about twice an hour when the outside temperature was 49°, as shown. When it was 25° outside, steam turned on five times an hour. Fig. 6 (Left) A thermometer in the center of the third floor recorded only slight fluctuations between 70° and 74° although the outside temperature dropped more than 20° from Tuesday to Thursday

exposures in each zone. In the store zone, the outdoor bulb was placed on the north walls and set so that with a north wind, the radiators would be supplied with enough steam to offset the heat loss from the north exposure. At the same time, the radiators on the east and south exposures would be hotter than necessary to offset the heat loss from their respective walls. With the heating system valved so that one control controlled the steam supply to each exposure, a further savings could be expected. This refinement would be especially valuable if the floors are broken up by walls and partitions.

One or two various things were brought to our attention in regard to this control and one that stands out most prominently is the fact that a very definite dead-end type of pressure reducing valve is required on the heating system to make the control function properly and be efficient. In this particular case, the pressure reduction is made by one step, namely, from 130 lb. inlet pressure to about 3 lb. on the low side, and when both controls shut off at the same time, as they frequently do, the reducing valve should be as stated above—a dead-end valve so as to keep as much circulation of steam out of the risers as possible.

We also found that this type of valve was very responsive and sensitive to the heating system demands, and when the system was completely full of steam but not ready for the control to shut it off, very little steam was being delivered to the system. Naturally, the valve is properly sized so that when all the load is on it is very nearly in the wide-open position.

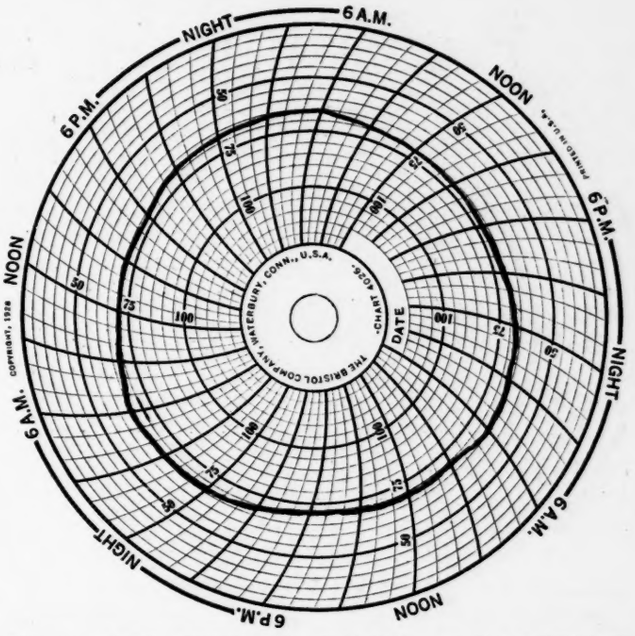


Fig. 7. Little temperature fluctuation in the warehouse was registered by the recording gauge after the control was installed

While gratifying savings in steam consumption have been indicated by this installation up to the present time, no tabulation of savings in steam consumption has been shown in this article, because we are waiting until the end of the heating season to show the actual steam consumption for this building by months, and also the pounds of steam per degree-day.

Development of Low Cost Housing in Europe

WHILE the subject of low-cost housing has come in for considerable attention on this side of the Atlantic, both from public and private agencies, development along these lines has not progressed here to the extent that it has in Europe, where our overseas friends have not been idle. America may well observe these foreign projects, with an eye to profiting by the experiences of others.

Housing experts in Europe are leading the way toward the optimum in economic planning and production and to effective architectural design adapted to the changing social order through considering the community house as the unit of production, rather than the individual dwelling. Several European nations, notably Germany, England, Holland, France, Switzerland, and Austria have made important advances in supplying quality housing to the lower income groups.

This has been accomplished largely through government financing, amounting in most cases to assistance, although in others it is actually government subsidy in which public funds are invested or loaned at less than cost. In all events, this has led to low interest rates, low amortizations and depreciation rates, elimination of wasteful speculation costs, and low administrative costs. Coupled with these are the economies achieved through large-scale planning and construction, to which end the best in architectural and technical thought has been applied.

Dwellings complying with the minimum standards Europeans have generally set for this kind of construction, can be rented at an annual rate of from 6% to 8% of the cost of the investment, the rent being reduced to 5% in cases where government subsidizing exists. These figures compare with the 12% to 15% required as the return on similar structures built speculatively in the United States.

European standards for low cost housing run somewhat as follows: One complete apartment for each family, to include kitchen, toilet, living room, and bedrooms. Running water, gas, or electricity are provided. One bedroom for the parents, one for boys, and one for girls is the rule, all bedrooms to have direct ventilation. All rooms to be light, and where possible, should have sun exposure. These dwellings are a part of a neighborhood unit, which also provides facilities for social life. Rents are not to exceed one-fifth of the annual income of the family occupying the quarters.

Proper Planning and Layout Methods Cut Costs in Pipe Welding

By D. W. HICKEY†

"Separation and orderly execution of the work, efficient methods, proper and sufficient tool equipment, organizes both the work and the men. The contractor pays for the wasted time if he does not provide the system."

ORGANIZATION on a welded pipe job depends on the separation of work to such an extent that an efficient system of procedure can be applied to each part of the work. In addition to good organization, it goes without saying that good mechanics and proper tools are necessary for the best results.

There are four separate and distinct operations on any welded pipe job: Layout, cutting, erection, and welding. Each can be done independently and without interfering with the other if they are carried out in their proper order. All can be done by one man or several, but they should be treated as four distinct operations, to be performed at different times in order.

The type of workmen will vary on different jobs. On the larger jobs they can be picked for their ability at one thing and kept continuously busy at layout, erection, or welding. On the smaller jobs the foremen should be a good layout man, able to cut with the torch, and capable of handling the erection of the piping. The welder, in addition to being a good welder, should be at least a good helper who is willing and anxious to learn the steamfitting business, and who will do his share of the work when there is no welding to do. The welder should not be laid off when the welding has been completed, but should be considered a permanent and important member of the crew which finishes up the job. The transient welder pays his way only as long as he is kept busy at the actual welding, because he does not fit in with the crew and usually cannot handle the various work that is given to him to do when he is not welding.

Separation and orderly execution of the work, efficient methods, proper and sufficient tool equipment, together with supervision that provides steady work for every member of the crew 8 hr. a day, organizes both the work and the men. The contractor pays for the wasted time if he does not provide the system and insist that it be followed.

Layout

Layout is important on any piping job, and on the welded job there are additional tasks, such as making patterns for headers. Whether the details are handled in the office or on the job, they should be handled by one man who knows his business and knows the plans of the job. The measurements which must be taken for welding are in all respects the same as on any other piping job, center to center or end to end, but instead of screwing on a valve or a fltting it is welded on. However, on the welded job, fewer measurements are required because on long runs where tee connections are required, the branch is run back to the main and welded in wherever it may come.

The additional layout work is the pattern making for the fittings fabricated on the job or in the shop by welding. Those for holes in headers and mains, saddles to fit, mitered angle joints and special fittings such as Y's are ordinarily about all the patterns required on a welded job. Center-lining the pipe before the patterns are made must be done accurately, but this is a fast and simple operation if it is done right. A center finder and a straight piece of 2 in. angle iron is all that is needed. The angle iron is laid on the pipe and

†Jewel Mfg. Co., St. Paul, Minn.

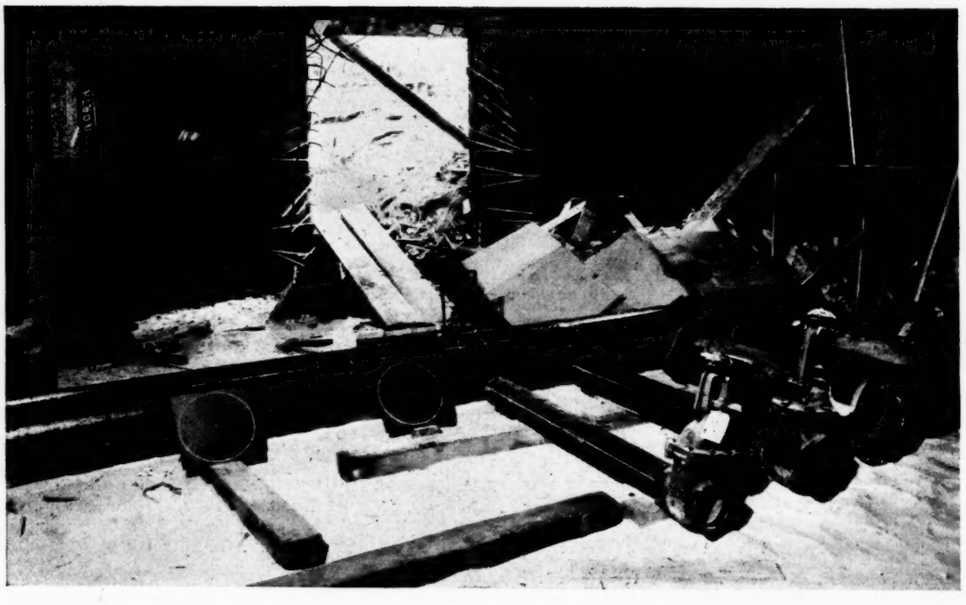


Fig. 1. Header ready for cutting, the layout having been made by using a pipe marker.

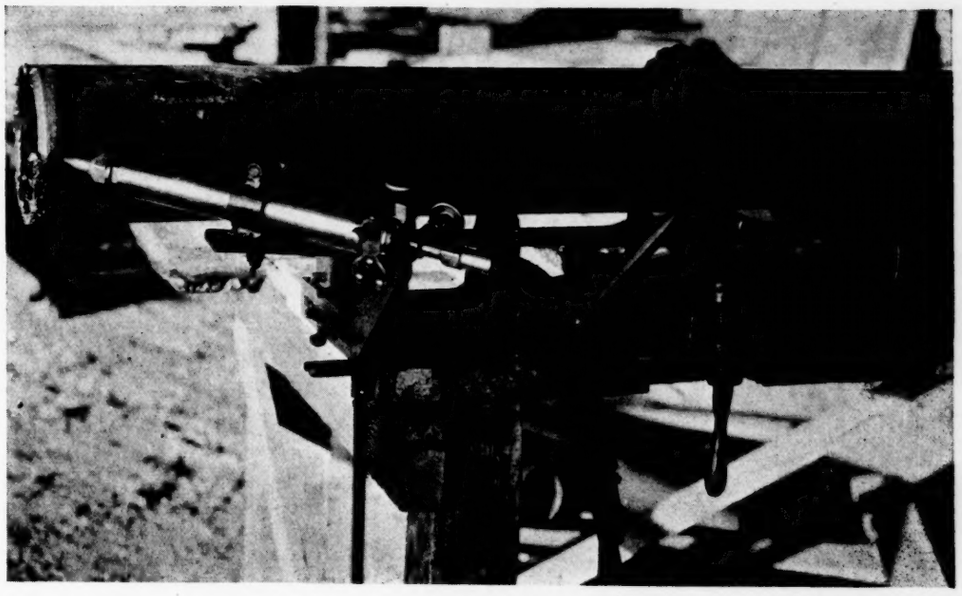


Fig. 2. A cutting machine gives straight, clean joints for welding.

the exact center of the pipe is marked with soap stone on either edge of the angle iron; the center finder is placed on the top of the pipe at this mark and the other end of the steel rule locates the exact opposite center of the pipe. The angle iron is then laid on this mark and the exact opposite center line is drawn. The center of the opposite side can also be measured with a steel rule around the pipe.

Different sized header holes and saddle patterns are made quickly and without the use of templates by a pipe marker. (The header illustrated in Fig. 1 was laid out in this manner.) Since the pipe marker is a mechanical device, the pattern it lays out is accurate. Accurate layout saves the time required for both the cutting and the welding, because the pieces do not have to be trimmed to make them fit and the welder has an even spacing all around the weld, making a better and a faster weld. Layout on the welded job is the same as on any other job, with the exception of pattern making, and this can be simplified by the use of the proper tools. Paper or metal templates serve the same purpose as the pipe marker but a complete set of them for all sizes up to 12 in. would include about 100 patterns.

Cutting

Cutting with the acetylene torch is the easiest part of the welder's job to learn, and all of the real machanics on the job should be taught how to cut. Cutting is fast and simple, and the man that can cut properly never has to have his job held up. An 8 in. piece of standard pipe can be cut with a beveled end ready for welding in less than 2 min., actual welding time, resulting in a clean cut with no ridge on the outside and no burr on the inside.

Every job of any size should have one complete extra set of good cutting equipment and two or three of the men should be proficient at cutting. Substantial and inexpensive anchors can be made with U-bolts and angle iron. The angle iron is cut to the desired length to bridge the sleeve and two holes cut in it for the U-bolt to fit the pipe. Anchors can be made up for the entire job at the bench or in the shop and one man can cut up a number of angle iron for anchors in an hour when he has nothing to do but cut. Anchors for a battery of risers can be made up on the job in the same manner, fastening several pipes to the same piece of angle iron with U-bolts. Piping can be cut without waiting in the erection of long lines of piping and anchors, and pipe, rod, plates, and holes in steel beams can be cut for the plumbers.

If there is a man on each job who can cut the pipe and get it ready for erection, one welder can take care of the welding on several jobs. Then the piping can be clamped in position and ready for the welder. A sufficient number of clamps are necessary in order to handle the work efficiently in this manner. The man that does the layout work can also do the cutting, or if layout

Fig. 3. Steam main ready for a welder. Joints to be welded are shown inside the white circles, other joints having been welded before erection. The pipe clamps for lining up can be seen.

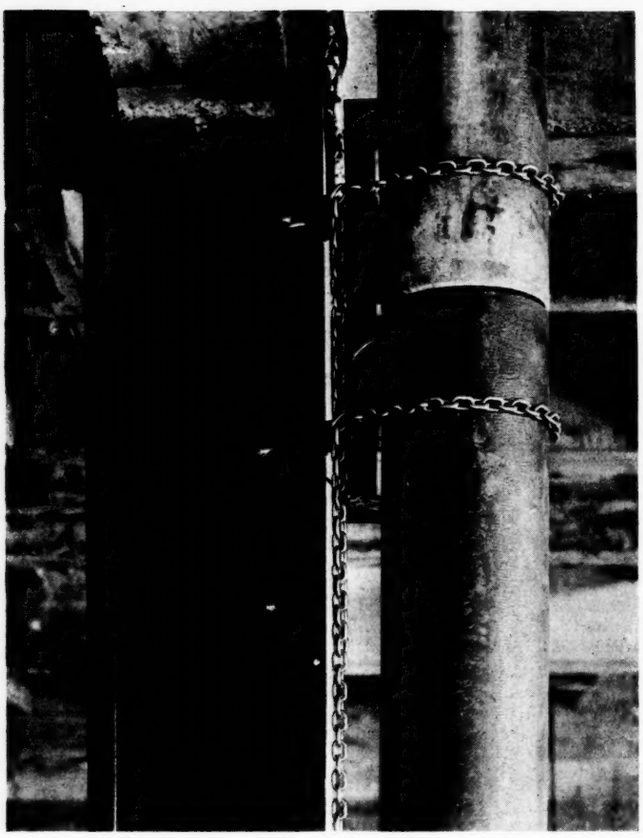


Fig. 4. A 10-in. steam riser clamped in position ready for the weld

alone keeps him busy he can let the work pile up until the welder does the job.

Fig. 2 shows a cutting machine that was used on the same job for straight cuts. Its operation will be apparent from the picture as will the quality of the work it does. A straight clean bevel machine cut is faster than a hand cut, consumes less gas, and permits the welder to make a faster and a better weld.

Erection

Pipe erection is a job in itself. The men who erect the pipe finish their job when they are on any line. Hangers are installed first. On the straight lines of piping they pull the pipe up into position, fasten the hangers, rigidly clamp the pipe in its permanent position, and the job is done. This is true of mains, headers, or risers. Layout, cutting, and welding on all the work possible is done at the bench or on the ground where the cutting and welding can be done cheaper and faster.

Erection requires the same operations whether the job be flanged, screwed, or welded. The difference is after the pipe is on the hangers in its approximate permanent position. On the screwed job the joints have to be screwed up with chain tongs, and on the welded job the joints are clamped in their permanent position, completed with the exception of the actual weld.

Clamping devices are necessary if the job is to be completed with the exception of the actual welding. The pipe clamps should be a type that will fit several different sizes of pipe or fittings. The lighter they are, consistent with the strength required for the job they have to do, the better. A sufficient number of clamps is necessary so that the men erecting pipe are not held up waiting for clamps and so that when the welder starts to work he can weld continuously and work alone. A pipe clamp should be fastened to the end of each piece of pipe before it is erected. The projecting end of the clamp provides something solid on which to rest the end of the next piece of pipe and the process of clamping is simpler when one end of the clamp has been secured to the pipe.

Pipe erection on mains and risers becomes a matter of stringing up the pipe and clamping it rigidly and permanently. No threads to make up and no flanges to bolt up, but finished erection ready for the weld. Fig. 3 shows a steam main located on the 12th floor ceiling clamped in position and ready for the welder. Welding fittings at the corners had one weld made at the bench. Two inch or 2½ in. connections were taken off this main approximately every 12 ft. but the arms were run back to the main before the welder started. Erection done in this manner is fast because the biggest job is getting the pipe up in its position and there is practically no work to the clamping operation. Pipe clamps straighten out the lines if the fitter uses a little judgment when putting them on.

Fig. 4 shows a 10-in. main steam riser clamped in position ready for the weld. On this riser the welder worked on the line at the same time as the fitter and

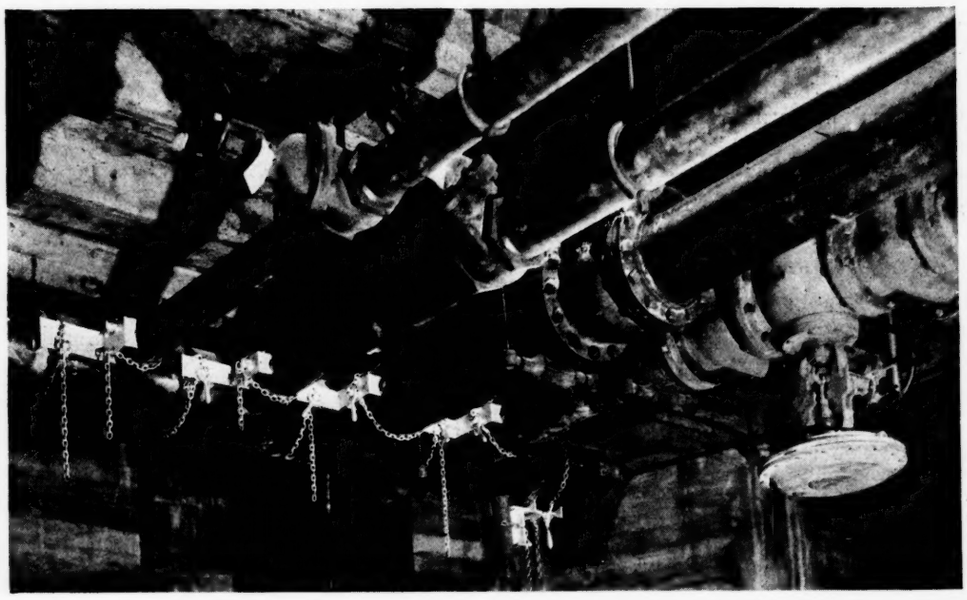


Fig. 5. One method of lining up a header. The flanges are made up and bolted to the valves and the pipe hung permanently before the weld is made at the header.

two helpers. A large pipe clamp was fastened to the end of the first length of pipe and it was raised to a vertical position and anchored at the first floor, and blocked in the shaft to hold it solid. The second length was pulled up with an electric crab and dropped down on top of the first length, where, after the proper spacing was secured, the top of the pipe clamp was fastened to the bottom of this pipe. The second length was blocked in the shaft to keep it from swaying, the cable removed, and the clamp held the 10 in. pipe in position and maintained the spacing. The welder started to weld this joint and followed the joints right up to the top of the building.

The headers shown in Fig. 5 and 6 are clamped in their permanent position and ready for the welder. They are completed with the exception of the actual welding.

Using the method illustrated in Fig. 5, practically no lining up is required on the header, because the flanges are all made up and bolted to the valves, and the piping hung permanently before the weld is made at the header. Ordinarily a header has to have the flanges squared up both ways before it is hung so that the piping will all go out at right angles to the header, but by making up the header in the manner illustrated any slight adjustment that may be required can be made on the hangers or with the clamps on the header before the weld. Such a header, and practically all large tee connections, require that the back of the pipe be heated and then sometimes cooled in order to prevent expansion and contraction from warping the pipe. The method of header construction shown eliminates on the ordinary job the necessity of fastening the header to heavy I-beams with U-bolts and wedges to prevent warping and assure perfect lineup of the face of the flanges. Heating to prevent warping is a matter of experience and judgment and a good welder has no trouble straightening out his piping.

A definite system of pipe erection, completely detached from other operations, saves wasted time on both the erection and the welding.

Welding

The best advice that can be given any contractor by any one on the actual welding is *Hire a good welder or train one.* If his torch is faulty or his gauges do not work he will tell you. When he starts to weld he does his job fast and he has no leaks. A pressure of 2 lb. or 200 lb. makes no difference if he knows his business. Once he starts to weld no one can help him; he works alone. A steamfitter or helper can watch him but no one can help him make the actual weld. Books can be written on how to weld, but that information is for the welder. Knowledge and practice will increase his speed and make his welds better, but when it comes to the actual welding everything is up to him. A good welder, with rare exceptions, has no leaks in his welds. If he does he is at least a careless welder. Pin holes in welds are unnecessary and these welds are not the work of a good welder. The manufacturers of welding equipment and gas have service men that are glad to check welders and their welding, and they offer the contractor every safeguard as far as the weld itself is concerned. If you do not know anything about the actual welding, get the information from some one who does.

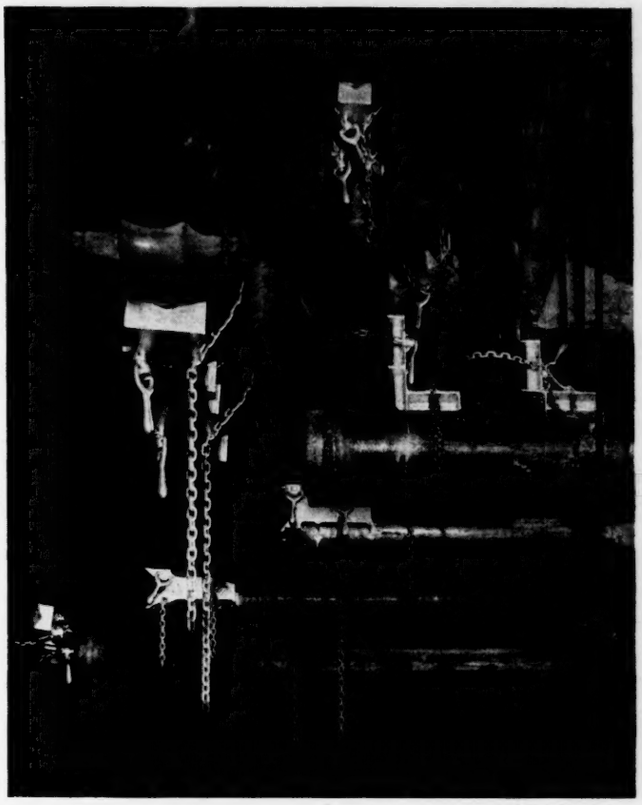


Fig. 6. Clamps for lining up connections to the steam header permit easy lining up

One welder, according to the tables furnished by the manufacturers of welding apparatus, can make a 4 in. puddle weld in from 10 min. to 15 min., actual welding time. The question is how to average three or four 4-in. welds per hour, 8 hr. a day, and six days a week. The welder will take care of this, if the joints are lined up and ready for the weld. Welding is like painting, a separate and distinct operation, and should be treated as such. You cannot buy welding by the gallon or by the can, or put it on like paint or putty, but you can use it that way, and that is the way to make welding pay. Consider it as one item on the job that must be done just the same as the radiators must be painted, either before or after they are set, not while you are setting them.

The problem on a welded pipe job is not the welding. The problem is layout and pipe erection, ready for the weld. Layout, cutting, and erection need the organization and the system to keep the piping erected ahead of the welder. This applies to the work in the shop as well as on the job.

A welded pipe job is better for the owner, the contractor, and the steamfitter. If the contractor organizes his work properly his cost will be at least no more than the screwed job, and his tool costs and office overhead will be considerably less. The all-welded pipe job gives more skilled work to the local steamfitter and welder than the screwed job, and the difference to the contractor is more than offset by the saving he makes on fittings, threads, tools, covering, and overhead.

New Light on Heating System Corrosion

By J. H. WALKER†

Studies by the National District Heating Association with the corrosion tester indicate a consistent relation between oxygen and corrosion and no relation between carbon dioxide and corrosion

THIS article describes a new device for measuring corrosion, particularly in heating systems, and gives the results obtained by its use in buildings located in three different cities. The use of a testing device as a corrosion indicator is not new but its application to heating system corrosion is a rather novel approach to a problem which has been somewhat baffling, largely because of the lack of suitable test apparatus.

The results indicate that the condensate in the building heating systems was much more corrosive than the condensate formed directly from the steam as supplied, and that the type of heating system and the method of operation are important factors. These findings appear to confirm the theory that oxygen, introduced by the inleakage of air, is a major factor in corrosion. The work was sponsored by the Corrosion Subcommittee of the National District Heating Association.

Present Status of the Corrosion Problem

Among the many factors which influence corrosion are carbon dioxide and oxygen, which are usually entrained with the steam and therefore become dissolved in the condensate; the kind of metal of which the piping is made, and its degree of homogeneity, and—as is now demonstrated—the type of heating system and the way in which it is operated. Our present knowledge of the problem of corrosion may be said to be largely qualitative because we do not know definitely the effect of various amounts of carbon dioxide and oxygen in the steam supply or the specific effect of several other factors. There is no real proof that many building heating systems are deteriorating faster than should normally be expected and the actual sums spent on repairs in nearly all buildings are quite negligible. Occasional incidents of leakage or of stoppage by corrosion products, however, naturally disturb the building owner. We need laboratory and field studies to answer the many questions involved.

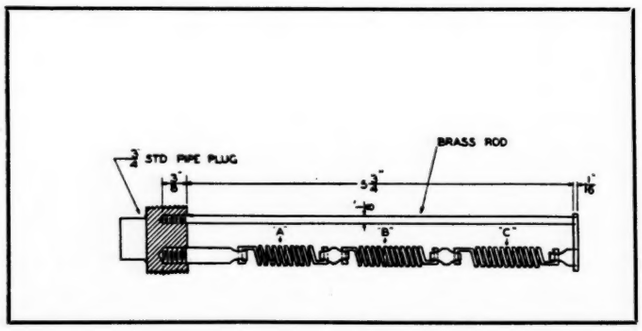
The fundamental phenomena involved in heating system corrosion have been studied by several investigators[1]. From a chemical standpoint the three basic factors are oxygen, carbon dioxide and water. Most steam supplies, whether generated in an isolated boiler or obtained from a district steam system, contain carbon dioxide, derived from the feedwater in which it usually exists either as dissolved gas or in chemical combination. Carbon dioxide is difficult to eliminate by ordinary methods of feedwater treatment. Oxygen, also a natural impurity, can be almost entirely removed by deaeration of the boiler feedwater, but it frequently reappears in appreciable quantities in the condensate within the heating system due to absorption from the inleaking air.

Hall and Mumford[2] call attention to an important fact regarding the ability of the condensate to hold dissolved gases, and it should be borne in mind that it is only when in solution that oxygen or carbon dioxide are corrosive. They point out that, according to well known physical laws, the amount of gas in solution should vary directly with the partial pressure of that gas in the atmosphere above the surface of the water, and that the content of oxygen and carbon dioxide in

†Superintendent of Central Heating, The Detroit Edison Company, and Chairman of N.D.H.A. Corrosion Subcommittee.

[1]For complete discussion see "Corrosion: Causes and Prevention," F. N. Speller, McGraw-Hill Book Co., Inc.

[2]"Some Fundamental Considerations of Corrosion in Steam and Condensate Lines," by R. E. Hall and A. R. Mumford, A.S.H.V.E. Journal, November and December, 1931.



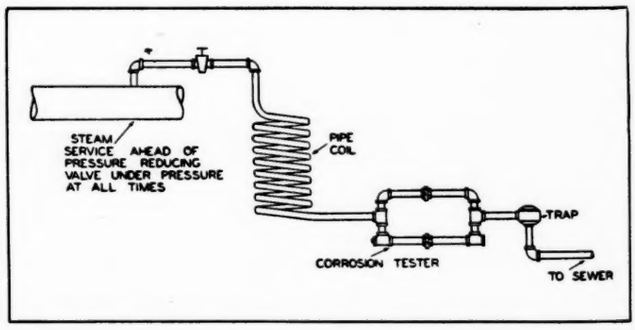


Fig. 1. (Left) N.D.H.A. corrosion tester. Wire coils made from Bessemer steel wire 0.05" (± 0.0005") in diameter. Made from steel below upper 1/3 of ingot. Annealed, pickled and packed in lime. Before use, wire is brushed, wound into coils, and immersed in hot ether for 30 min., dried and weighed. Fig. 2. (Right) Corrosion tester installed to measure effect of condensed steam from the supply pipe.

steam is usually so low that their partial pressures are very small and the quantity of gases theoretically possible in solution is minute. That this is undoubtedly true in the case of condensate which is in the presence of steam of normal gaseous content, is borne out by the fact that in steam lines under continuous pressure there is little gas found dissolved in the condensate. Internal corrosion in the many miles of pipe used in district steam systems throughout the country is practically unheard of. In the heating systems in buildings, however, a different condition exists. Both oxygen and carbon dioxide can accumulate in radiators and water heaters which are imperfectly vented and relatively high partial pressures can build up. This is especially true of carbon dioxide which usually is present in exceedingly greater amounts than is oxygen.

Raw water may have an oxygen content at 70° of as much as 6.2 cc. per liter. Deaeration will reduce this to a very small amount—little more than a trace if an effective deaerator is used—but in heating systems there is much opportunity for reabsorption of oxygen by the condensate from that inexhaustible reservoir, the atmosphere. If the heating system is a vacuum system there will usually be many leaks through which air will be drawn, and in a pressure system there is plenty of opportunity for inleakage and oxygen absorption whenever the steam is shut off.

Picture what happens when the steam is turned off from a radiator or from the entire system. As the residual steam condenses the pressure drops below atmosphere and air rushes in through air vent valves or through leaks. It finds the metal surfaces covered with a film of condensate, hungry for oxygen. As this condensate cools to, say, 100°, it is able to absorb a large amount of oxygen, theoretically 4.65 cc. per liter. Thus, the removal of oxygen from the water prior to its entering the boiler does not guarantee freedom from oxygen corrosion in the heating system.

The Corrosion Tester

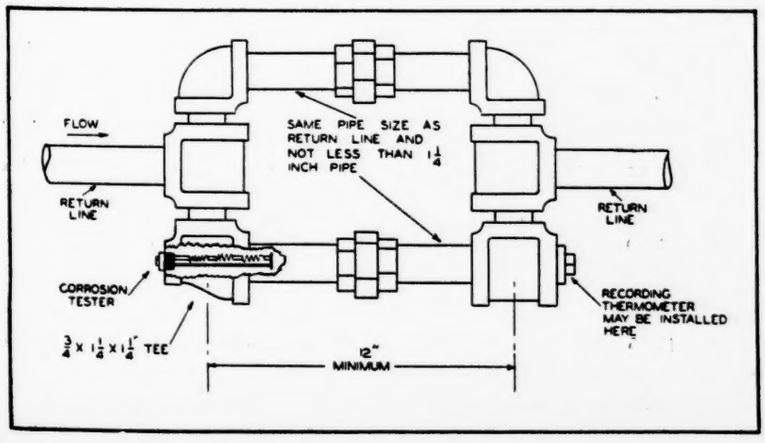
It had been evident for some time that there was a need for some kind of a corrosion test which would show quantitatively the corrosion rate at any point in the heating system. It was believed that this would throw considerable light on the corrosion problem and would make it possible to correlate the chemical and physical conditions of the condensate with the actual rates of corrosion produced by those conditions. What was needed was an accurate, short-time test.

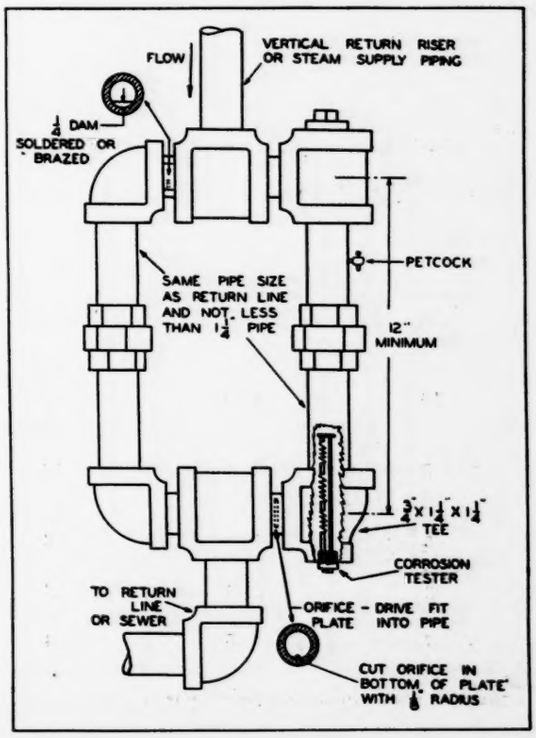
The testing device which was developed, known as the N.D.H.A. corrosion tester, makes use of coils of steel wire which are carefully weighed and then exposed to the steam or condensate for a definite period, after which the corrosion products are removed and the loss in weight is determined. The device, shown in Fig. 1, resembles somewhat the tester devised by Chapman[3]. The coils of wire are of helical shape and are supported on a frame and insulated so as to preclude the possibility of electrolytic action. The wire is of Bessemer steel of a diameter of 0.05 in. and was especially made for the purpose from a heavily cropped ingot and drawn to the very close tolerance of plus or minus 0.0005 in. This latter precaution is essential because the surface area is calculated from the weight of the specimen. The wire has been pickled and is kept in lime to prevent corrosion before use. The coils are of approximately 11/16 in. outside diameter, and each coil weighs about 3 grams and has about 2 sq. in. of surface. The exact composition of the steel used was not considered of major consequence, but it was important that the composition be uniform so that the results would be comparable. The same general type of steel is used, however, in a large amount of pipe.

[3]Described in *Power*, August 11, 1931.

Fig. 3. (Below) Corrosion tester installed in dry return line

Fig. 4. (Right) Corrosion tester installed in return riser or down flow steam riser


FLOW
SAME PIPE SIZE AS RETURN LINE AND NOT LESS THAN 1¼ INCH PIPE
RETURN LINE
RETURN LINE
CORROSION TESTER
RECORDING THERMOMETER MAY BE INSTALLED HERE
¾ X 1¼ X 1¼" TEE
12" MINIMUM


FLOW
VERTICAL RETURN RISER OR STEAM SUPPLY PIPING
¼ DAM SOLDERED OR BRAZED
PETCOCK
SAME PIPE SIZE AS RETURN LINE AND NOT LESS THAN 1¼ PIPE
12" MINIMUM
¾ X 1¼ X 1¼" TEE
CORROSION TESTER
TO RETURN LINE OR SEWER
ORIFICE - DRIVE FIT PLATE INTO PIPE
CUT ORIFICE IN BOTTOM OF PLATE WITH ⅛" RADIUS

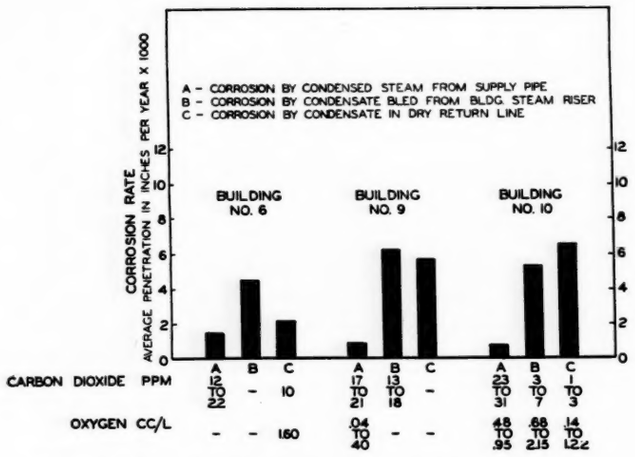

A - CORROSION BY CONDENSED STEAM FROM SUPPLY PIPE
B - CORROSION BY CONDENSATE BLED FROM BLDG. STEAM RISER
C - CORROSION BY CONDENSATE IN DRY RETURN LINE
CORROSION RATE
AVERAGE PENETRATION IN INCHES PER YEAR X 1000
BUILDING NO. 6
BUILDING NO. 9
BUILDING NO. 10
CARBON DIOXIDE PPM
OXYGEN CC/L

Fig. 5. Results obtained with corrosion testers in three buildings with one-pipe systems

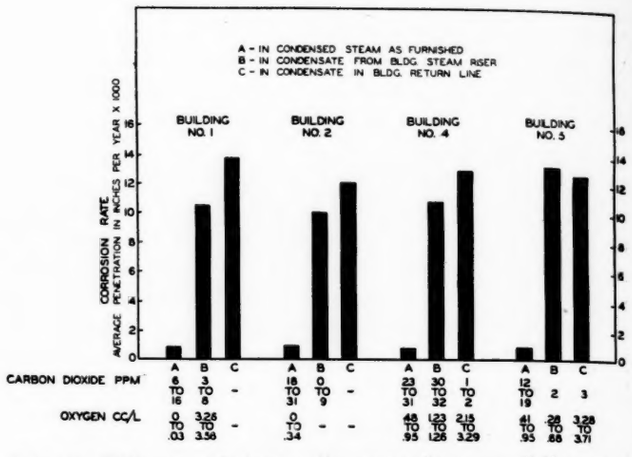

A - IN CONDENSED STEAM AS FURNISHED
B - IN CONDENSATE FROM BLDG. STEAM RISER
C - IN CONDENSATE IN BLDG. RETURN LINE
CORROSION RATE
AVERAGE PENETRATION IN INCHES PER YEAR X 1000
BUILDING NO. 1
BUILDING NO. 2
BUILDING NO. 4
BUILDING NO. 5
CARBON DIOXIDE PPM
OXYGEN CC/L

Fig. 6. Difference between the corrosiveness of the condensate from the steam supply and that in the building heating system

The installation of the corrosion tester presents certain problems. It is essential that the tester be exposed to conditions substantially the same as the conditions to which the pipe itself is subject. If the pipe is completely filled with condensation, the tester must be completely submerged, and if the pipe is intermittently wetted, the tester should likewise be intermittently wetted. The method of installation, therefore, differs in different parts of the heating system.

Fig. 3 shows the method used in installing the tester in a horizontal return line which may carry air or gases as well as condensation. The tester was installed in a tee which forms part of a U-shaped loop with an air vent over the top. Thus, when installed in a return line which runs partly full of condensate, the condensate was forced to flow over the corrosion tester which was thus subjected to conditions similar to the submerged inner surface of the pipe.

When installed to measure the effect of condensate formed from the steam as supplied, the tester was arranged as in Fig. 2. Steam was drawn from the supply pipe into a condensing coil, whence the condensate flowed over the tester.

The method of installation in a so-called dry return riser was more complex. The tester must be submerged when condensate is flowing down the pipe, but must be dry when the pipe is dry. To accomplish this the condensate was dammed up by means of an orifice plate (Fig. 4) so that as long as an appreciable amount of condensate was flowing the tester was submerged. The orifice permitted the condensate to flow out of the short piece of pipe holding the tester so as to empty it in a short time. The by-pass prevented the filling up of the riser.

Removal from the wire of the corrosion products, which were chiefly iron oxide, called for considerable care. Mechanical removal was impracticable, and the electrolytic method is quite complicated. The method finally chosen was the use of an acid solution containing enough inhibitor to minimize the attack of the acid on the metal itself. Careful tests conducted with uncorroded wire coils indicated that the errors introduced by this cleaning method were negligibly small. It was found that an exposure of about four weeks was sufficient to give a measurable loss in weight if the weighing is done on a delicate chemical balance. This period was therefore adopted as the standard test period.

In calculating the corrosion rate from the loss in weight of the wire specimen, one complication enters. As the diameter of the wire is decreased due to the

TABLE 1.
SUMMARY OF RESULTS FROM 36 CORROSION TESTERS

Number of* testers used	Oxygen, concentration cc. per liter	CO_2, concentration p.p.m.	Corrosion rate, in. penetration per year × 1000	Testers were immersed in:
7	0.34	20	0.90	Condensate produced by bleeding steam from the supply pipe and passing it through a condenser.
10	0.80	16	4.55	Condensate produced by bleeding a steam line of a pressure heating system (inside the building) and passing it through a condenser.
5	2.22	10	9.75	Condensate produced by bleeding a steam line of a vacuum heating system and passing it through a condenser.
5	1.20	6	5.80	Condensate bled from the dry return lines of pressure heating systems.
2	2.00	3	9.06	Condensate in the wet return lines of pressure heating systems.
7	2.95	4	12.45	Condensate bled from the dry return lines of vacuum heating systems.

*Each tester comprises three specimens of wire

effect of the corrosion, the area exposed to corrosion becomes progressively smaller. This fact should be taken into account mathematically in computing the corrosion rate. It does not, however, exert a significant effect unless the diameter of the wire has been considerably reduced.

Obviously, the results obtained with the tester must be interpreted with caution. In such a short time test there is not as much opportunity for the initial corrosion products to exert a protective effect as is the case with pipe exposed for long periods. Also, the surface of the tester wire is somewhat different from that of pipe. Consequently, the results should be taken as indicative of the relative and inherent corrosiveness of the condensate rather than the exact corrosion rate of any particular kind of pipe. Further work will be necessary to calibrate the tester in terms of the probable life of pipe. With these precautions in interpreting the findings the device appears to have considerable value.

Use of the Tester

The corrosion tester was thus developed and the consistency of its results was demonstrated by preliminary tests. It was decided to attempt by its use to throw some light on two important questions; namely, *What is the relative corrosiveness of condensate containing various proportions of carbon dioxide and oxygen?*

What are the relative corrosion rates in different parts of a building heating system?

Through the cooperation of members of the association, testers were installed in various types of heating systems in three different cities. Previous work had brought out the difficulties of obtaining a correct and representative sample of steam or condensate and a thorough technique was therefore worked out and used throughout this study. One major error that is often made is that of failing to differentiate between a sample of the *steam*, with the gases entrained in it, and a sample of *condensate* as it exists in the heating system. If steam is drawn from the pipe, condensed in a coil and cooled to a low temperature, the condensate as it cools is capable of dissolving much greater quantities of gas than is the condensate within the pipe. Consequently, if an analysis of the gases entrained with the steam is desired, a sample of steam should be withdrawn from the pipe and condensed in a coil; but if an analysis of the condensate is wanted, a sample of *condensate* alone should be drained from the pipe. The necessity of observing these and other precautions has led to the description of standard methods of sampling and analyzing[4].

Results

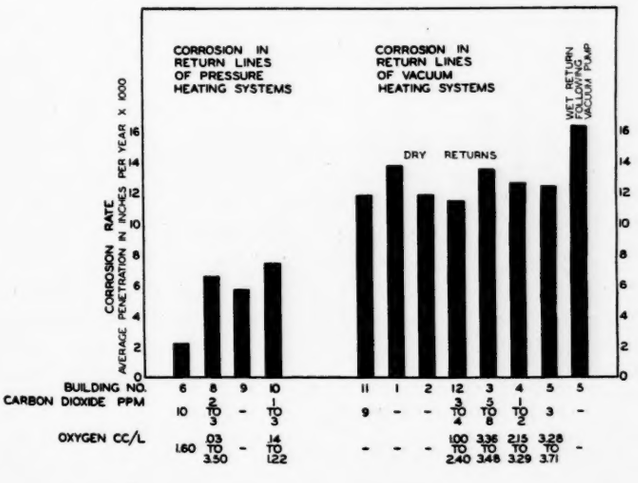
It is evident that in tests of this sort, made under operating conditions, it is impossible to control those conditions exactly and it is difficult to obtain a complete history of the temperature, pressure, and gas content which have existed during the time of exposure of each tester. To compensate for this lack of scientific exactness a considerable number of cases have been studied and the results considered collectively may be said to be fairly representative. The close agreement between various buildings of any one type supports this assumption.

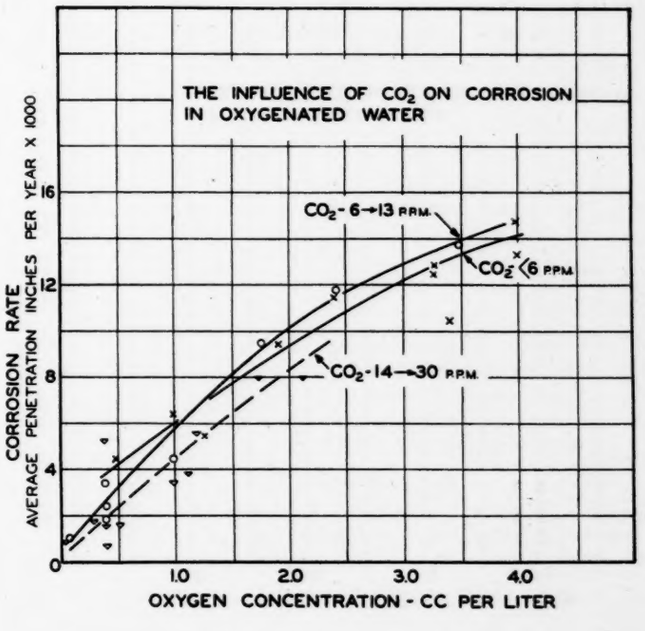
Fig. 5 shows the results obtained with the corrosion testers in three buildings having one-pipe systems operated at pressures above atmosphere. The corrosion in the steam risers and in the so-called dry return lines was very much greater than the corrosion caused by the condensate formed from steam drawn from the supply pipe. The difference was undoubtedly due to the oxygen periodically absorbed by the condensate covering the tester (and the inner surfaces of the pipes) in the heating system. This explanation is rather well

[4]This booklet is obtainable without charge, by applying to D. L. Gaskill, Secretary, National District Heating Association, Greenville, Ohio.

Fig. 7. (Below) Comparison of corrosion rate in return lines of pressure systems and that in vacuum systems.

Fig. 8. (Right) Corrosion rate plotted against oxygen content indicates a rather consistent relation between the two


CORROSION IN RETURN LINES OF PRESSURE HEATING SYSTEMS
CORROSION IN RETURN LINES OF VACUUM HEATING SYSTEMS
DRY RETURNS
WET RETURN FOLLOWING VACUUM PUMP
CORROSION RATE AVERAGE PENETRATION IN INCHES PER YEAR X 1000
BUILDING NO.
CARBON DIOXIDE PPM
OXYGEN CC/L


THE INFLUENCE OF CO_2 ON CORROSION IN OXYGENATED WATER
CO_2 - 6→13 P.P.M.
CO_2 <6 P.P.M.
CO_2 - 14→30 P.P.M.
CORROSION RATE AVERAGE PENETRATION INCHES PER YEAR X 1000
OXYGEN CONCENTRATION - CC PER LITER

borne out by the analyses from Building No. 10, shown below the chart. Note that the condensate formed from the steam as supplied was obtained as shown in Fig. 2 and this method usually entraps in the condensate all of the gases entrained in the steam. The testers placed in the building heating system, however, were subjected to condensate which was always in contact with the steam or vapor in the pipe and the concentrations of the gases dissolved in this condensate were therefore not as great as the concentrations of gases in the pipe, but were a function of the partial pressures of the gases in the pipe. The basis of comparison, therefore, is unfavorable to the steam as supplied.

The difference between the corrosiveness of the condensate from the steam supply and that in the building heating system is even more pronounced in vacuum systems, as illustrated in the four buildings shown in Fig. 6. In every case the condensate in the building steam riser was about ten times as corrosive as the condensate from the steam in the supply pipe and in all cases the condensate in the dry return lines was at least twelve times as corrosive. The theory that this is due to air inleakage in this type of system is extremely plausible in view of the analyses, which show large amounts of oxygen.

Let us now compare the results from the return lines of the pressure and vacuum systems, shown together in Fig. 7. The amounts of corrosion in the vacuum systems are too consistently greater than those in the pressure systems to be disregarded, and the conclusion is unavoidable that the two-pipe vacuum system sets up conditions which are inherently more corrosive than those in one-pipe positive pressure systems.

Table 1 shows the summarized data from all tests and the averages bear out the results obtained from the individual buildings shown in Figs. 5, 6 and 7. Note the low average carbon dioxide content and high oxygen content of the condensate drained from various points in the heating system, as compared with the condensed steam as supplied.

The question naturally arises as to whether or not the corrosion rate indicated by the testers placed in the return lines, amounting to 0.012 in. average penetration per year, is a seriously rapid rate. This question cannot yet be answered because, as previously pointed out, the corrosion rate of the tester is not necessarily the corrosion rate of the pipe and because whatever protective effect the corrosion product may produce has not come into action. Eventually, it is hoped that enough results will be obtained to enable the tester to be calibrated in terms of seriousness of corrosion; but for the present these results are to be regarded purely as relative results. In none of the buildings in which tests were made is corrosion regarded as a serious problem.

Relation of Oxygen and Carbon Dioxide to Corrosion

When the work with the corrosion testers was first planned it was hoped that enough results would be obtained to show quantitatively the relation of oxygen and carbon dioxide to the rate of corrosion. It was expected that the gaseous content of the steam in the different cities where the testers would be used would vary considerably and that the amount of corrosion plotted against oxygen and carbon dioxide content would furnish some sort of an answer to this question. Actually, however, it was found that there was as much variation from time to time in individual cases as there was in the steam supplied in the different cities. Moreover, it was impossible in a field test of this duration to obtain a complete history or time-weighted average of the existing chemical conditions and of temperatures, pressures, etc. Deductions which may be drawn as to the effect of oxygen and carbon dioxide should therefore be regarded as indicative rather than conclusive.

With these reservations in mind let us examine Fig. 8. The results have been grouped in three classes—those having less than 6 parts per million of carbon dioxide, those between 6 and 14 p.p.m., and those between 14 and 30 p.p.m. The corrosion rates have been plotted against the oxygen content and an attempt made to draw separate curves through each of the three groups of points. The results clearly indicate a rather consistent relation between oxygen content and corrosion and no definite relation between carbon dioxide content and corrosion. In other words, within the limits of carbon dioxide encountered, oxygen seems to be decidedly the controlling factor.

Conclusions

The experience gained with some 36 N.D.H.A. corrosion testers installed under various conditions indicates that the tester is a convenient and apparently reliable short-time indicator of corrosion rates, although the results must be considered as relative, pending correlation of the tester readings with actual pipe corrosion.

Results obtained with the tester in several buildings supplied from district heating plants show that the corrosion rate in the building heating systems is very much greater than the corrosion produced by condensate formed from the steam as supplied and passed continually over the testers. This is ascribed to a predominating effect of oxygen which is present only in small amounts in the steam supplied but in much greater amounts in the condensate within the heating system due to air inleakage in the case of vacuum systems and to intermittent operation in the case of systems operating at positive pressures.

The corrosion rates found in vacuum systems are consistently greater than the corrosion rates in pressure systems, but in each type of system there is no great difference between the corrosion rates in the supply pipes of the building heating system and the corrosion rates in the condensate return pipes.

The results from a large number of cases indicate, subject to the inaccuracies introduced by fluctuating conditions, that the corrosion rate increases with the oxygen content but that, within the range of concentrations which existed, there is no consistent relation between rate of corrosion and carbon dioxide content.

Selecting the Design or Outside Temperature for Heating Calculations

IT is somewhat surprising that the matter of outside temperature upon which to base the design of a heating system has been given as little attention as it has. This "design" temperature in each town or city has seemingly been determined largely by trial and error, and in some cases possibly persists mainly because of tradition.

Selection of a design temperature for a given city is usually made by one of the following methods:

(1) **Using the figure commonly accepted by engineers and contractors located in the city under consideration.**
(2) **Using a temperature in the neighborhood of 15° above the lowest recorded temperature for the city.**
(3) **The method proposed in several standard textbooks on heating, "not more than 15° above the lowest recorded temperature as reported by the Weather Bureau during the preceding 10 years."**
(4) **Calculating the radiator surface from charts or sheets for which the outside temperature is not specifically stated, but is combined with other factors.**
(5) **By studying Weather Bureau records and by judgment selecting that combination of design temperature and wind velocity that seems best to fit the requirements.**

It is believed that there is confusion among engineers between methods (2) and (3). While some textbooks give the wording as quoted in (3) they at the same time refer to tables of lowest temperatures which have been used for years, and which obviously will change from time to time, if the 10-year clause is to apply. This method (3) is also open to question from the standpoint that rigidly to follow it would require the design temperature to undergo a change as often as once a year, and certainly every few years. Apparently, many engineers use method (3) without noticing the 10-year clause, or because they feel that it is unimportant, so that they are actually using method (2).

The rule outlined in both methods (2) and (3) is really no rule at all, for a latitude of 15° is allowed by the wording. A design temperature equal to the lowest temperature, or one 15° above that, or any intermediate temperature can be used.

The question of design temperature is not usually of great interest to an engineer until he finds it necessary to determine such a base for some remote city where he is not in touch with local practice. In such cases designers frequently write to this publication asking what temperatures are used. To make such data available in some permanent form, we decided to collect information from readers located in the important cities as to what design temperatures are commonly used in their locality.

Such a questionnaire had also a secondary, although minor purpose—to determine whether actual practice conformed to method (2), and if not, to attempt an explanation. The persons to whom letters were sent, however, were simply asked for the design temperature being used, as it was felt that more complete returns would be obtained than if more than one question were asked.

Replies were received from 96 cities. In some cases two figures were received from the same person, with the note that consulting engineers and architects use the lower figure while contractors use the higher. The difference between the two figures was always either 5° or 10°. The two were averaged, in spite of the fact that with those with a 5° difference the resulting figure was an odd number.

From the information tabulated in Table 1 enough figures were available to fill in partially a map of the county, shown in Fig. 1. This was done merely to give a general picture of the zones, and not for the determination of the correct design temperature for a specific city, and should not be used for such a purpose. Obviously, for specific cities it may be inaccurate due to the distances between points and occasional wide deviations from a smoothed curve. In the Rocky Mountain district and the southwestern states too few replies were received to allow the plotting of even a general picture of the zones.

In addition to giving replies concerning their cities, some engineers gave us design temperatures commonly used in smaller cities in their general locality. Inasmuch as most printed tables do not cover such places, their figures together with pertinent comment, are included below.

West Virginia: "We feel that the engineer calculating heat loss should make a study of the temperatures recorded in the various districts in which he operates and select his outside temperature and temperature differences from these figures. The rule of using 15° above the lowest recorded temperature the writer would be inclined to term a 'thumb rule'.

"In answer to your question for Wheeling, W. Va., we use an outside temperature of 0°, except for certain local areas located on the top of hills or in districts where a greater number of sub-zero mornings are known to exist. We arrive at these figures from a study of temperature records which show that temperatures in 1930 reached –5°, and in 1929 –8°. Records show that temperatures in the 1929-30 heating season were colder than normal, and about as cold as any previous season, with a few exceptions. Records also show that Wheeling, during the 1929-30 heating season, had 20 days below 10°, 13 of which were below zero.

"The following table gives the data sheet we use for West Virginia":

OUTSIDE TEMPERATURE RECORDS

City	Elevation	Lowest Temperature, 1929	Lowest Temperature, 1930	Days below 10°, 1929-30 Heating Season	Days zero or lower, 1929-30 Heating Season	Prevailing Wind Direction	Outside Temperature to be used for design
New Cumberland..	671	−4	−4	15	8	S.	0
Wheeling	645	−8	−5	20	13	S.W.	0
Parkersburg	638	−4	−0	10	1	S.W.	10
Huntington	538	−1	1	7	0	S.W.	10
Charleston	600	2	3	7	0	....	10
Bluefield	2563	−5	2	10	2	....	10
White Sulphur	1914	−4	−6	11	5	....	0
Elkins	1947	−10	−14	15	4	W.	0
Weston	1026	−12	−12	9	2	....	0
Clarksburg	1015	−9	−12	12	5	S.W.	0
Grafton	1000	−10	−16	11	5	....	0
Morgantown	1250	−6	−6	13	3	S.	0
Martinsburg	435	−4	−4	10	2	....	10

Texas: In the western part of the state one engineer uses the infiltration method with a 20-mile wind on account of the high winds encountered in that part of Texas. Design temperatures are:

Abiline, 14; Austin, 22; Childress, 4; Corpus Christi, 28; Dallas, 14; Fort Worth, 14; Gainesville, 10; Galveston, 28; Houston, 24; Marshall, 18; Modland, 14; Sherman, 10; Wichita Falls, 6.

Those designed for a 20-m.p.h. wind are: Amarillo, 4; Dalhart, 2; Lubbock, 10; Plainview, 10.

Louisiana and Mississippi: The same engineer quoted above uses the following:

Jackson, Miss., 20; Shreveport and Monroe, La., 18.

California: "The base temperature for computing radiation in Sacramento and contiguous territory, including the cities of Stockton and Fresno (which are in the San Joaquin Valley) is plus 30°.

"We use the above base temperature in estimating radiation requirements for all cities located in the Sacramento and San Joaquin Valleys where the elevation does not exceed 250 ft. above sea level. In the mountainous districts and also the foot-hills adjacent to Sacramento and the other cities named, there is, of course, a wide variation of temperature. In the Sierra Nevada range, temperatures as low as −30° are sometimes experienced at an elevation of approximately 8000 ft. There are a number of small cities located in the high mountain ranges of California, and radiation requirements for the San Joaquin and Sacramento Valley districts do not, of course, apply to such localities."

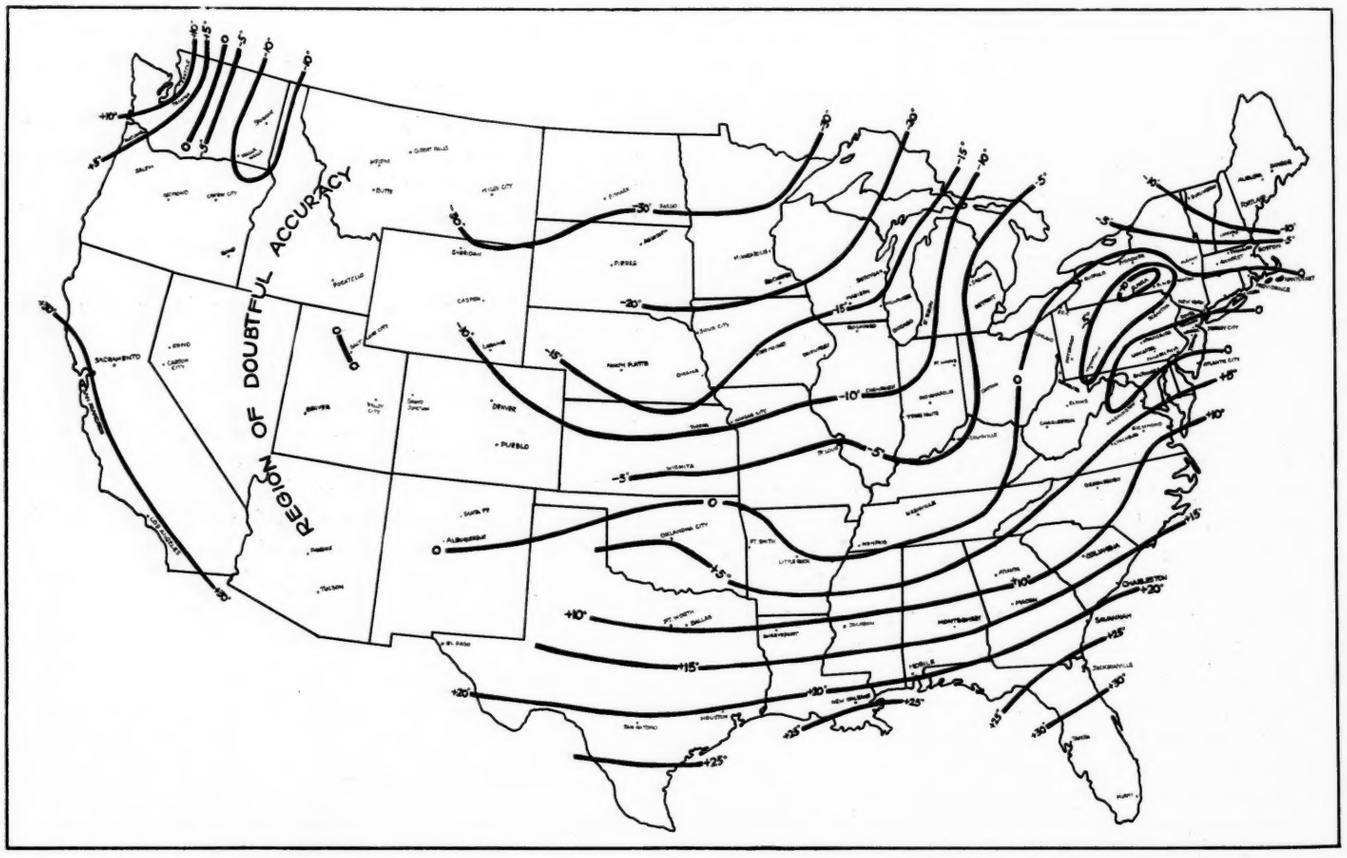


Fig. 1. General zones of constant design temperatures. This map shows only the approximate relationship between the geography of the country and the design belts, and should not be used to determine the correct figure for specific cities. Plotted from figures supplied by readers of HEATING AND VENTILATING from 96 cities

TABLE 1

LOWEST RECORDED TEMPERATURES AND DESIGN TEMPERATURES USED in 96 CITIES

(Lowest recorded temperatures from publications of the U. S. Department of Agriculture, Weather Bureau, covering long periods from 20 to 50 years up to about 1922. Design temperatures those used by readers of HEATING AND VENTILATING*)*

State	City	Lowest Recorded Temp., °F.	Design Temp. Actually Used, °F.
ALABAMA	Birmingham	−10	10
	Mobile	−1	20
	Montgomery	−5	15
ARKANSAS	Fort Smith	−15	−15
	Little Rock	−12	0
CALIFORNIA	Los Angeles	28	30
	Sacramento	19	30
	San Francisco	29	30
CONNECTICUT	New Haven	−14	−5
DIS. OF COLUMBIA	Washington	−15	0
FLORIDA	Jacksonville	10	27
	Pensacola	7	20
GEORGIA	Atlanta	−8	10
	Macon	−4	10
	Savannah	8	20
ILLINOIS	Champaign	−25	−10
	Chicago	−23	−10
	Rockford	−26	−10
INDIANA	Fort Wayne	−24	−10
	Indianapolis	−25	−5
	Terre Haute	−18	−10
IOWA	Davenport	−27	−10
	Des Moines	−30	−15
	Sioux City	−35	−18
KANSAS	Topeka	−25	−5
	Wichita	−22	−5
KENTUCKY	Louisville	−20	−5
LOUISIANA	Baton Rouge	2	20
	New Orleans	7	25
MARYLAND	Baltimore	−7	0
MASSACHUSETTS	Amherst	−22	0
	Boston	−14	0
	Fitchburg	−17	0
	Nantucket	−6	0
MICHIGAN	Detroit	−24	0
	Saginaw	−23	0
	St. Joseph	−21	−10
MINNESOTA	Minneapolis	−33	−15
	Rochester	−42	−20
MISSOURI	Kansas City	−22	−10
	St. Louis	−22	−5
NEBRASKA	Omaha	−32	−20
NEW HAMPSHIRE	Concord	−35	−10
NEW JERSEY	Atlantic City	−7	0
	Dover	−21	0
	Jersey City	−12	0
	Newark	−13	0
	Patterson	−13	0
	Trenton	−13	0
NEW MEXICO	Albuquerque	−10	0
NEW YORK	Albany	−24	−10
	Binghamton	−28	−5
	Buffalo	−14	0
	Elmira	−24	−10
	New York	−13	0
	Syracuse	−22	−2
NORTH CAROLINA	Greensboro	−3	20
NORTH DAKOTA	Bismarck	−45	−30
	Fargo	−48	−30
OHIO	Cincinnati	−17	−5
	Cleveland	−18	0
	Dayton	−16	0
OKLAHOMA	Oklahoma City	−17	5
OREGON	Portland	−2	5
PENNSYLVANIA	Erie	−16	5
	Harrisburg	−14	0
	Lancaster	−27	0
	Philadelphia	−6	5
	Pittsburgh	−20	0
	Scranton	−15	−5
	Uniontown	−22	0
	York	−17	0
RHODE ISLAND	Providence	−12	0
SOUTH CAROLINA	Charleston	7	20
	Columbia	−2	10
SOUTH DAKOTA	Aberdeen	−46	−20
TENNESSEE	Chattanooga	−10	0
	Nashville	−13	0
TEXAS	Dallas	−10	10
	Fort Worth	−24	14
	Houston	6	20
	San Antonio	4	20
UTAH	Salt Lake City	−20	0
VERMONT	Burlington	−28	−10
VIRGINIA	Lynchburg	−7	0
	Richmond	−3	10
WASHINGTON	Seattle	3	10
	Spokane	−30	−10
	Tacoma	7	10
	Walla Walla	−17	−10
WEST VIRGINIA	Wheeling	−25	0
WISCONSIN	Madison	−29	−15
	Milwaukee	−25	−17
	Sheboygan	−38	−10
WYOMING	Laramie	−42	−10
	Sheriden	−45	−30

Unusual conditions, even within a town or city, have their effect on the selection of outside temperature. An example of this is stated by an engineer with a gas company, who replied that it was the policy of his company to use a design temperature 5° lower than commonly used in that city because of the fact that owners of gas-heating systems expect much more of their plants than do those who have hand-fired coal plants. Another engineer uses a design temperature 5° lower than the city base for buildings adjacent to the city, and 10° lower farther out where exposures are unusually severe.

The lowest recorded temperatures were found from Weather Bureau publications and tabulated for each of the 96 cities. These were then compared with the figures received from our readers, and grouped according to the number of degrees margin of safety allowed above the lowest recorded. They grouped themselves as follows:

Design temperature as used is—degrees above lowest recorded:	Number of cities falling in each group
0 to 5	4
6 to 9	10
10 to 14	32
15 to 19	23
20 to 24	21
25 to 29	5
30 to 34	1

The average for the whole number was 15.3°, and this number coincided with the median, indicating that 50% of the cases use design temperatures more than 15° above the lowest recorded temperature and the other 50% below the 15° above. In other words, of those replying, half do not fall within method (2). Of the half that do fall within the rule, the average is about 10° above the lowest recorded temperature.

We can safely conclude, therefore, that the rule in method (2), inasmuch as it does not agree with practice in half the cases, is of doubtful value.

Philadelphia Puts on Aggressive Renovizing Campaign

EARLY in 1933 a group known as the Philadelphia Federation of the Construction Industry, comprised of several hundred representatives from all branches of the building trades, launched the "Renovize Philadelphia" campaign, an organized drive to encourage the citizens of that city to repair, remodel, and restore their premises at today's bargain prices. After six weeks of intensive advertising and soliciting, for the most part contributed services, the people of Philadelphia had pledged themselves to in excess of $21,000,000 to be spent in rehabilitating their residential and business buildings.

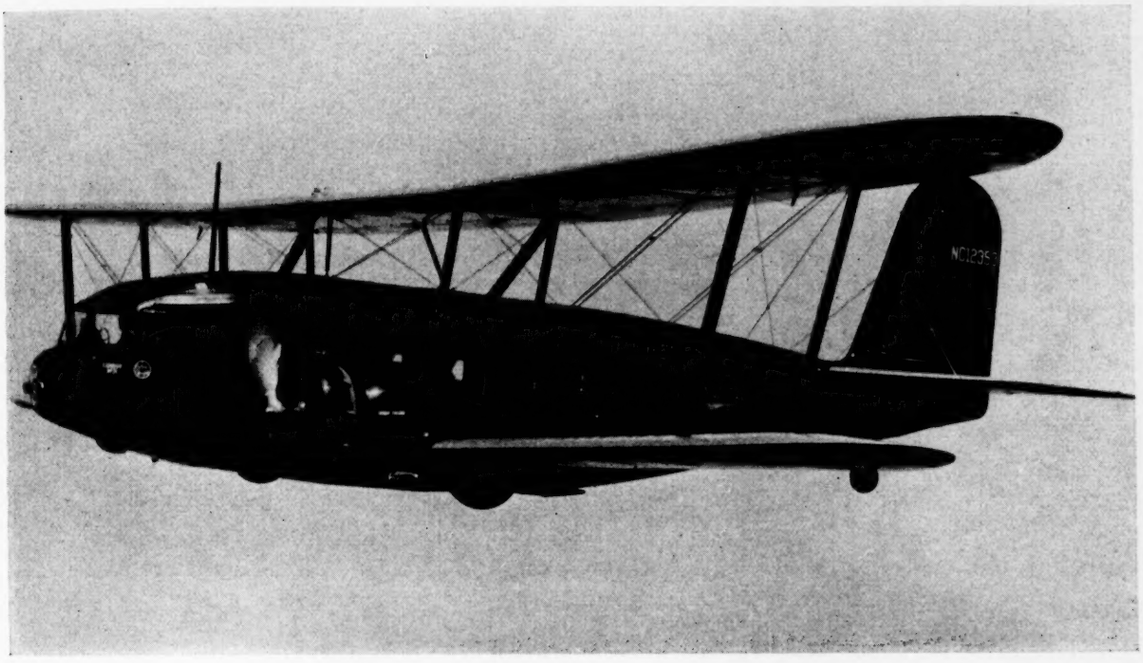
First conceived about a year ago by Dr. Frank Parker, professor of finance at the University of Pennsylvania, as a means of increasing employment, putting money into circulation, and benefiting real estate values, the plan did not get under way until he had spent several months in investigating and planning. William A. Law, chairman of the Committee on Home and Mortgage Financing of the Third Federal Reserve District, was made general chairman of the campaign committee, and a general council of 40 members, men and women prominent in business and social activities, was formed. Nine operating committees were then set up to handle the details.

Publicity was, of course, the most vital factor contributing to the success of the movement. This was placed in the hands of N. W. Ayer & Son, which gave its services gratis. With "Good Business for You and Good for Business" as its slogan, the Renovize Philadelphia movement presented its message to the public from eighteen full-page newspaper advertisements, from broadcasting stations, from outdoor billboards, posters on street cars, window placards, news releases to the press, and many other media. In addition to this, there was much incidental publicity given the plan, as the idea caught with the people, aided by a friendly press. A budget of $40,000 covered the expenses of the campaign, since all the publicity facilities were contributed. This fund was largely subscribed by the public utilities, banks, insurance companies, department stores, and the building trades. Actual soliciting was done by 7000 volunteer workers, whose coming was prepared by the mailing of a million descriptive pamphlets by utilities and the larger banks.

A "Renovize Exposition," where new materials were on display along with examples to illustrate what could be accomplished through modernization, was conducted in a central office building by the Architects and Engineers Committee. It was open daily from 9 until 5:30, and property owners with questions were given free architectural and engineering advice as far as this might be done without encroaching upon the rights of the professions.

The greater volume of the work pledged came from the business buildings, some of which represented entirely new constructions. The Business Building Committee worked in five divisions concentrating on industries, banks, stores, hotels, and apartments and office buildings, respectively. How much of the $21,000,000 committed will actually be spent will require some time to determine, as the pledge was not to be construed as a legal contract. In the meantime the volunteer workers are revisiting the property owners to check up on the progress. It is believed that the Philadelphia people have become "renovize-minded," and that the result of the campaign will be to stimulate construction for some time to come.

Heating and Ventilating Airplanes Without Noise



The first silent liner of the air—a Curtis-Wright Condor

TO be able to converse in normal tones in an airplane cruising at 150 miles an hour sounds like an impossible but greatly to be desired condition.

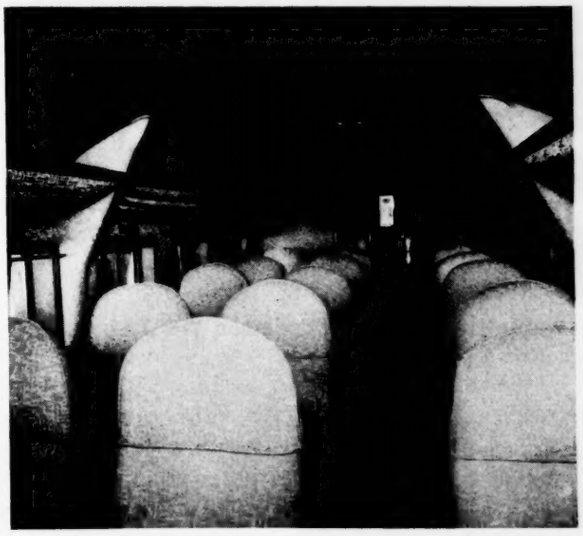
This has been accomplished in the initial plane of a fleet of 15-passenger Condor transports, recently built by the Curtiss-Wright Corporation for Eastern Air Transport. Noise is reduced by the insulation of warm and cold air ducts. The warm-air pipes consist of an inner pipe which is perforated and an outer shell of stainless steel. The space between the perforated pipe and the outer shell is filled with spun glass to deaden any possible noise, while felt is the silencing material used in the cold-air pipes.

Noise is further reduced by the use of geared propellers which turn more slowly than those with direct drive, thus producing less of the propeller whine induced by the speeding blade tips, and by muffling the exhaust of the engines, which are mounted in rubber.

Noise tests made in the plane while travelling indicated a count of 75 decibels, in comparison to 105 decibels in ordinary planes. A Pullman train travelling under ordinary favorable conditions registers 75 decibels.

Aeronautical research conducted by the Guggenheim Foundation showed that poor ventilation is one of the principal causes of air sickness. The ventilating system installed in the Condor transport is the latest and most improved of its type. Two large air ducts are installed in the ceiling of the plane so that a complete change of air in the cabin takes place every 3 min., permitting smoking in each individual seat, the smoke being carried directly upward to the ceiling ventilators.

Warm air for the passenger and pilot compartments is provided through the use of a seamless stainless steel tube approximately 6 ft. long, around which the hot exhaust gases circulate, heating the air inside this pipe, which due to the high speed of the ship is forced through to the cabin, furnishing warm air to each passenger, as well as to the pilots. This warm air entering the passenger compartment from either wall near the floor is spread horizontally through the cabin, thus first heating the air near the floor. The volume of warm air, regulated by the passengers, rises to the ceiling and discharges through two large ceiling ventilators. The temperature of the warm air entering the soundproofed ducts leading to the passenger seats is controlled by the pilot. This air can be regulated from a



Interior of plane showing ventilator in ceiling

General arrangement of heat distribution system in framework of plane

maximum of 120° down to the outside air temperature.

The passenger cabin, including the floors, walls and ceiling, is insulated from the welded steel fuselage by acoustical insulation, also preventing as much noise as possible from entering the passenger and pilot compartments.—*P. Golding.*

New Constructions Developed for Standardizing Homes

APPEARANCE on the market of new building materials and the continued development of new construction methods point to progress in the field of low cost factory-built housing. All of these innovations indicate a trend toward reduced labor in erection, a lighter construction, and a minimum of weight to be transported. To this end, designers and manufacturers have sought generally to assemble floors, roofs, and walls, together with windows and doors, into prefabricated units incorporating structural members with the adjoining walls.

Materials include rolled and pressed steel, gypsum, asbestos sheets, lightweight reinforced concrete slabbing, aluminum, wood and various manufactured compositions. Wall sections can be shipped from the factory in standard size, with window and door frames ready in place and provision for framing already made, permitting erection of the building with a minimum of welding, riveting, bolting, or masonry work in the field.

Our cover shows the United Fruit Company's new "S.S. Veragua." York Ice Machinery equipped, its mechanical plant represents advanced practice in marine air cooling and refrigeration.

The ways in which these materials may be assembled are almost unlimited. We find exterior walls and partitions consisting of metal-clad insulation board, supported between standard "tees" and channels bolted or welded together in the field. A variation of this consists of steel sheets pressed to form outer wall surfaces and columns as a single unit. These members are bolted together at the ends and insulation board is glued to the inside. The interior finish is of plywood, glued or nailed to wood strips. Pressed steel wall sections, formed with rectangular box corrugations or Z-shapes, are available. Insulation board is fastened to the outside of these to be covered with enameled metal or porcelain shingles for the outside finish, and plasterboard over which wall paper is hung forms the inside wall. The box-like spaces are filled with insulating material.

Other constructions utilize interlocking hollow tiles, cinder blocks, lightweight concrete slabs, etc., supported between upright channels. The outside surface is stuccoed, and the inside may consist of insulation, plaster, and any of a number of desirable finishes.

Interesting among the roof and flooring constructions are those of reinforced gypsum or concrete slabbing, supported on steel joists. A variety of floor surface materials can be applied to this type of flooring. Another construction, suitable for both floor and roof, consists of pressed steel panels formed with channel ends to serve as joists. Finished slabs of insulation are suspended from the lower side to form the ceiling. Other constructions consist of pressed steel Z-shapes or corrugations, sufficiently stiff to be placed without joists, finished on the top surfaces with wood, composition, or linoleum.

EDITORIALS

King Coal Bestirs Himself

WITHIN the month two events have occurred which affect bituminous coal possibilities in an outstanding way. First, a research agency has been organized, and second, a new marketing plan has received court approval. As bituminous coal is important as a building heating fuel in many districts the final results will eventually be felt by us.

Bituminous coal has been perhaps the fuel worst affected by the movement toward automatic operation. It has been held back by internal quarrels and labor troubles and by wildcatting in production and selling methods. Progress on the outside was blocked by failure to find solutions within. The new selling plan results from internal agreements and is confidently expected to remove some of the ills not only of selling but of producing as well. The present plan operates among the producers of four states and if successful is likely to be widely copied. Perhaps a formula has been found at last. At worst, a plan is better than no plan at all.

Although research in bituminous coal has fascinating possibilities, it has been retarded by the general troubles of the industry which prevented the producers lending active and organized support. Now a new agency is in existence and the machinery is set up. How successful it will be depends on the quality of its direction and support.

Here, then, are two new moves from which bituminous coal has much to gain potentially. They may eventually amount to much or little but everyone interested in the building fuel situation will want to keep in mind that the bituminous coal industry is continuing to bestir itself.

●

Mortgage Money

NOTHING is of greater importance to all branches of the building industry than the mortgage money situation. As an integral part of that industry we are all vitally concerned. Easy mortgage money has always meant good building activity and probably still does. Find a way to restore mortgage money and the building industry will be well set up in one of its basic essentials.

While mortgage money is tied up in the general situation—both monetary and economic—much of the trouble lies within the present mortgage situation itself. Regardless of other moves, straightening out of this tangle would itself go a long way to help building. The problem is generally recognized both within the industry and without, but the solution is not. There is general agreement that any effective move must be national and that the government must make it. Disagreement comes over the detailed plans advanced.

The latest administration plan calls for setting up means of making available to the owners of small homes sums of money up to 80% of the present valuation; for the transfer of mortgage claims to bonds with government guarantee of interest, and for a limited moratorium. It requires but little study of this plan to perceive that it is sharply limited in its application and that it is questionable whether it could ever work. In many of its features it still resembles the Home Loan Bank whose operations have gotten nowhere. The plan is distinctly an emergency measure and in no sense a full solution.

Considered by and large we as a group need expect little from it or from any plan of mortgage adjustments now receiving active consideration. The problem is broader than any one plan advanced, largely because each plan is advocated by a group of special pleaders to take care of their own interests. What is needed is a comprehensive plan to cover all existing mortgages. The other possibility is a rise in dollar income which will let mortgage borrowers discharge their obligations in the usual way.

●

Machine-Made Houses

DURING the period of slack business, many new building materials have appeared. They include new methods of fabricating steel, glass bricks, various synthetic boards, new concrete mixtures, new surface finishes, and many others. At the same time, a number of ideas have been advanced looking toward standardized methods of applying these new products—all with the ultimate hope that practical combinations will be found which will enable these new products to find useful applications in buildings.

The several steel dwellings recently finished are a case in point and some of their features of interest to us have already been described in these pages. Charles F. Abbott, of the American Institute of Steel Construction, at a recent meeting stated the present position of the steel construction interests when he said: "As a result of numerous experiments in recent years in the erection of houses of steel, methods have now been developed which warrant the industry to believe that small homes of steel framing can be built at no increase in cost over other types." If this is true it is likely to have as one of its results a new spur to urge advocates of all other materials to even greater efforts.

Through it all, and regardless of all else, each design still has to include a heating system, and we feel that the heating has as much to offer in the way of innovations in materials and ingenuity of method as will any other feature of any of these new designs of houses. It remains for us to see that the best of these new heating ideas actually get incorporated into the new designs.

Abstracts . . .

Reviews and Summaries of . . . . Current Papers, Books and Pamphlets

Use of Thermocouples in Measuring Wall Surface Temperatures

In laboratory temperature measurements of the heat flow between walls and air it is desirable to know accurately the real surface temperature of the wall. Methods of making such measurements have been questionable, and a test apparatus was set up to learn which method could be considered best.

Establishment of a temperature gradient to a position close to the wall surface was provided for. This gradient extended to the wall surface was considered as establishing the true surface temperature. Comparisons of this value with those indicated by various thermocouples attached to the wall surface in the several practicable ways would be possible. If the gradient showed the true temperature, then the error in the readings of the other couples could be found.

When the authors performed these tests they found that a couple made of wire as fine as No. 34 B & S having the junction and 3 in. of the leads embedded in the surface and sealed flush with plaster of Paris or cement, showed the true surface temperature for all practical purposes.

The paper describes the test apparatus in considerable detail and discusses the reasoning which led up to the test method. An explanation of the action of the several couples is also included.

[*Title: "Study of the Application of Thermocouples to the Measurement of Wall Surface Temperatures," by A. P. Kratz and E. L. Broderick. Presented at the A.S.H.V.E. annual meeting, January,* 1933; *approximately* 3000 *words,* 4 *graphs.*]

●

Home Building Conference Reports Cover All Angles in 11 Volumes

The complete set of 11 volumes on home building published by the President's Conference on Home Building and Home Ownership, now available, provides in one source valuable reference material for those interested in the subject from all angles. The heating engineer is directly concerned only with parts of a few of the volumes. Indirectly, however, as a part of the building industry, he can well be interested in the conference studies, for his work either is or may be affected by the mortgage situation, the development of community housing and other sociological aspects of building.

The titles and subjects covered in the set are:

Vol. I. Planning for Residential Districts. Covers city planning and zoning, relationship of size of plot to cost of utilities, street improvements, landscaping, and housing in lands adjacent to cities.

Vol. II. Home Finance and Taxation[1].

Vol. III. Slums, Large Scale Housing and Decentralization. Covers reports of the committees on blighted areas and slums, amalgamated projects of New York State Housing Board and other large operations, economic factors underlying housing and population trends.

Vol. IV. Home Ownership, Income and Types of Dwellings. Covers relation of business cycle to home owning, safeguarding the investment, relationship of income and the home, diagrams and description classifying various types of dwellings. This volume contains a wealth of material of particular value to manufacturers in the building field who make statistical studies of their markets.

Vol. V. House Design, Construction and Equipment[2].

Vol. VI. Negro Housing. Covers physical aspect of negro housing, social and economic factors, and existing housing projects.

Vol. VII. Farm and Village Housing[3].

Vol. VIII. Housing and the Community; Home Repair and Remodelling. Covers the relationship between housing and (1) health, (2) delinquency, (3) industrial worker's efficiency, (4) safety, (5) citizenship, (6) recreation, (7) education. Part 2, on modernizing, includes a check list for home inspection.

Vol. IX. Household Management and Kitchens. Covers household layouts, equipment, purchasing, budgets, and work areas including laundries and storage.

Vol. X. Homemaking, Home Furnishings, and Information Services. Covers, in addition to the first two subjects, sources of information on homemaking and furnishings.

Vol. XI. Housing Objectives and Programs[4].

[*Bound in blue cloth, 6¼ in. × 9¼ in.; approximately* 275 *pages each; price,* $1.15 *each, or* $10.50 *for the set. Obtainable from The President's Conference on Home Building and Home Ownership,* 42 *Broadway, New York City. Make checks payable to James Ford, Editor.*]

●

1933 Standards Yearbook Appears

The seventh edition of the Standards Yearbook continues to outline and summarize the situation in standardization work. However, it departs from the

[1]Reviewed in HEATING AND VENTILATING for June, 1932.
[2]Reviewed in HEATING AND VENTILATING for January, 1933.
[3]Reviewed in HEATING AND VENTILATING, for April, 1933.
[4]Reviewed in HEATING AND VENTILATING for April, 1933.

methods of the earlier editions in that more attention is given to the work and progress during 1932 and to an outline of how the standardizing agencies are attempting to make their recommendations effective. Detailed lists of international, federal, state, trade and technical organizations engaged in standardization are included and furnish a means of gaining a quick understanding of the agencies, their scope, their projects, and their methods. An extended bibliography is included.

[*Title: "Standards Yearbook,* 1933;" *cloth-bound, 6 in. × 9¼ in., 255 pages. A publication of the Bureau of Standards; obtainable by addressing the Superintendent of Documents, Washington, D. C.; price* $1.]

●

Heating Greenhouses

Circular No. 254, of the Department of Agriculture, is intended to aid in the design and improvement of greenhouse heating plants and gives data with regard to the layout and operation of modern systems.

A useful table shows the temperature range commonly maintained inside various types of greenhouses. Sketches and illustrations show the general arrangement and some detailed arrangements in both steam and hot water systems in greenhouses. Tabular information is included on estimating heat requirements, radiator quantities, and pipe sizes. Boilers, chimneys, and fuels are discussed and are illustrated in some cases. A chart gives the necessary grate area to be supplied to maintain a given inside temperature in a house of known glass area. Examples of applying the data to steam and hot water plants are worked out for small greenhouses. Schematic diagrams showing the application of automatic controls are included, as is a brief statement regarding the use of unit heaters.

[*Title: "Greenhouse Heating," by Arthur H. Senner. Circular No.* 254 *United States Department of Agriculture; paper-bound pamphlet;* 40 *pages;* 6 *in. × 9 in.; illustrated. Obtainable by addressing Superintendent of Documents, Washington, D. C.; price* 5 *cents.*]

●

Where to Locate Supply and Exhaust Grilles in Heating and Cooling Systems

Now that cooling is receiving more attention, the problem of distributing cooled air is always up for attention. No one likes to have to use a separate set of ducts for distributing cool air to a room if the heating ducts and outlets can be used. New constructions should make allowance for having the same set of ducts and outlets handle both the heated and the cooled air.

In order to discuss the subject, the author considers small rooms, schoolrooms, theaters, and low headroom spaces as separate types and takes up the problem as applied to each.

In small residence rooms using a warm-air circulating system he finds that low inlet and low return openings, such as those in common use in heating, should prove satisfactory as should also the use of high-located inlet and low-located exhaust. In radiator-heated small rooms where there is an air circulation from outside, he advocates use of a ceiling inlet and outlet fixture with a horizontal deflector for incoming air. He finds that this same plan can often be used to advantage in low headroom spaces such as in stores where each bent is separately handled.

In schoolrooms he reviews the methods in use and makes sketches to show the distribution to be expected. In theaters he seems to favor the downward plan with deflecting pans for the incoming air and adequate exhaust openings at low level. Difficulties under balconies can be taken care of by providing enough exhaust at these locations.

In certain cases the author advocates the use of vanes in taking off branches from mains and in ells leading to outlets.

[*Title: "Air Supply, Distribution and Exhaust Systems," by S. R. Lewis. Presented at the A.S.H.V.E. annual meeting, January* 1933; *approximately* 3000 *words,* 17 *sketches.*]

●

Revised Edition of "Fan Engineering" Now Available

Buffalo Forge's handbook, the well-known "Fan Engineering," is out in a reset and rewritten third edition. In general organization of material and in appearance it follows the earlier editions. Resetting and rewriting have permitted revision and the inclusion of the latest material. The sections devoted to air conditioning and air conditioning equipment have been enlarged to such a degree that numerous examples are worked out and a wide range of equipments are described and illustrated. The part devoted to the properties of air contains 170 pages of carefully annotated discussion introducing many original charts. India paper and small type make the book compact. The new edition will keep this book in its enviable position as one of the most widely used of all the commercial handbooks. The publisher states that the listed price is under cost.

Title: "Fan Engineering," 622 *pages; morocco fabricoid, flexible bindings; size* 4½ *in. × 7 in.; illustrated. Buffalo Forge Co., publishers; price* $3.

●

Welding with Heating Gas Studied by University

If welders could cheaply use the gas supplied through utility lines instead of having to depend on tank gases many a user would probably welcome the arrangement on account of its convenience. Many attempts to use manufactured, natural, and mixed gases for welding have met with but indifferent success. These gases are consequently of little commercial importance for welding purposes. It has usually been assumed that some of their constituents, such as sulphur, were the cause

of the trouble. That this is not the real reason is one of the conclusions reached after a protracted study of the performance of these gases in welding. Low temperature and insufficient heat are the real causes rather than the presence of sulphur. New designs of torches allowed the flame temperature to be increased 300% over those obtained with commercial torches and produced atmospheres in the welding zone which prevented oxidation. Strong ductile butt welds in 18-gauge sheet were made by hand at a rapid rate; cast iron and metals having melting points below that of steel were easily welded, but steel in thicknesses greater than ⅛ in. still presents an economic problem.

Title: "Welding with Manufactured, Natural, and Mixed Gas," Engineering Bulletin, Research Series No. 41, *Engineering Experiment Station, Purdue University, Lafayette, Ind., by H. H. Lurie. Paper-bound pamphlet;* 116 *pages;* 6 *in.* × 9 *in.; illustrated; price* 50 *cents.*

●

Influence of Air Conditioning on Home and School Life

An Ohio physician has recorded aerological observations made in his own home and in schoolrooms over a period of 10 years, during which a record of illnesses of the family was kept. The report is intended to show to what extent health, comfort, and efficiency are influenced by air conditioning and its functions, but the conclusions arrived at are frankly inpressionistic. The data are not sufficiently complete to permit conclusive proof, and no means for comparison is afforded.

Observations were made in a 2¾-story slate-roofed brick home, located at Columbus, Ohio. It is described as being in rather an exposed site, and containing approximately 20,000 cu. ft. of space. It is heated by a dual system consisting of a general gas-fired gravity warm-air plant, and auxiliary radiant gas heaters in quarters intended for sedentary occupation. A booster, consisting of a large gas-range burner, is inserted in the bathroom duct just before it ascends into the partition. Fuel economy is shown by costs for space heating which, ranged from $71 to $108 per year (1923-32). Natural gas of 1050 B.t.u. to 1100 B.t.u. per 1000 cu. ft., costing 55 cents per 1000 cu. ft., was used. Insulation and heating were the only controlled factors, and manual control was used entirely. Warm weather adjustments were partly met through the use of roof insulation and increased use of the basement part of the house.

The group consisted of eight members of the author's family, comprising three adults and five children, the latter ranging in age from eight to nineteen years at the time of the completion of the ten-year observation. All dressed lightly and conformed to a rational diet. Analysis of the various disabilities afflicting all members of the group shows a better than average health record, according to the author, and gives rise to the inferred conclusion that the state of nutrition and not the state of the air determines respiratory afflictions and their complications. The opinion is advanced that "bad air" may start colds, but that the resistance of the subject as determined by nutrition etc., determines the duration, complications, and results of these afflictions.

Data on air conditions in several schoolrooms in which comfortable conditions were reported are tabulated, along with an analysis of schoolroom heating, ventilating, and air conditioning considerations. The opinion is again stressed that bad conditions in the schoolroom will only serve to initiate colds, and that the degree of infection depends upon nutrition. If a comfortable atmosphere is provided, approaching the comfort zone, and is checked for unwelcome radiations, health and efficiency seem assured from the ventilation point of view. While insulation and temperature seem to be the only factors that need be controlled in the home, according to the author, because of crowded assemblage, and lack of supervision in the school, control of ventilation, recirculation, filtering, and warm season adjustment are necessary. Data are presented to show that other factors such as humidification, chemical composition, and exact fresh air quantity can be ignored.

[*Title: "Air Conditioning with Relation to Comfort, Health and Efficiency," by Emery R. Hayhurst, M.D., Ph.D., consulting hygienist, Columbus, Ohio; approximately* 5000 *words, with tabulated data. Read before Symposium on Air Hygiene, American Public Health Association, October* 25, 1932, *and published in the association's Journal, March,* 1933.]

●

Control of Chemical Content of Spray Water Advocated

Water sprayed across a stream of air will absorb the water-soluble substances in the air unless already saturated with them. If air passing through a spray type of conditioner contains much of this soluble material the water may absorb enough so that its content after being used for spraying will be decidedly different from what it was at the source of water supply. The longer the same water is recirculated the more soluble material it would be expected to absorb.

All this would make no particular difference unless the absorbed material were of a harmful nature. The writer of this paper quotes a case to show that the absorbed material caused a non-corrosive water to become highly corrosive, for the absorbed material contained free carbon dioxide, solids, and calcium sulphate. The pH value of the water which before use as spray water was 6.9, or nearly neutral, became 4.8 after use, or highly corrosive.

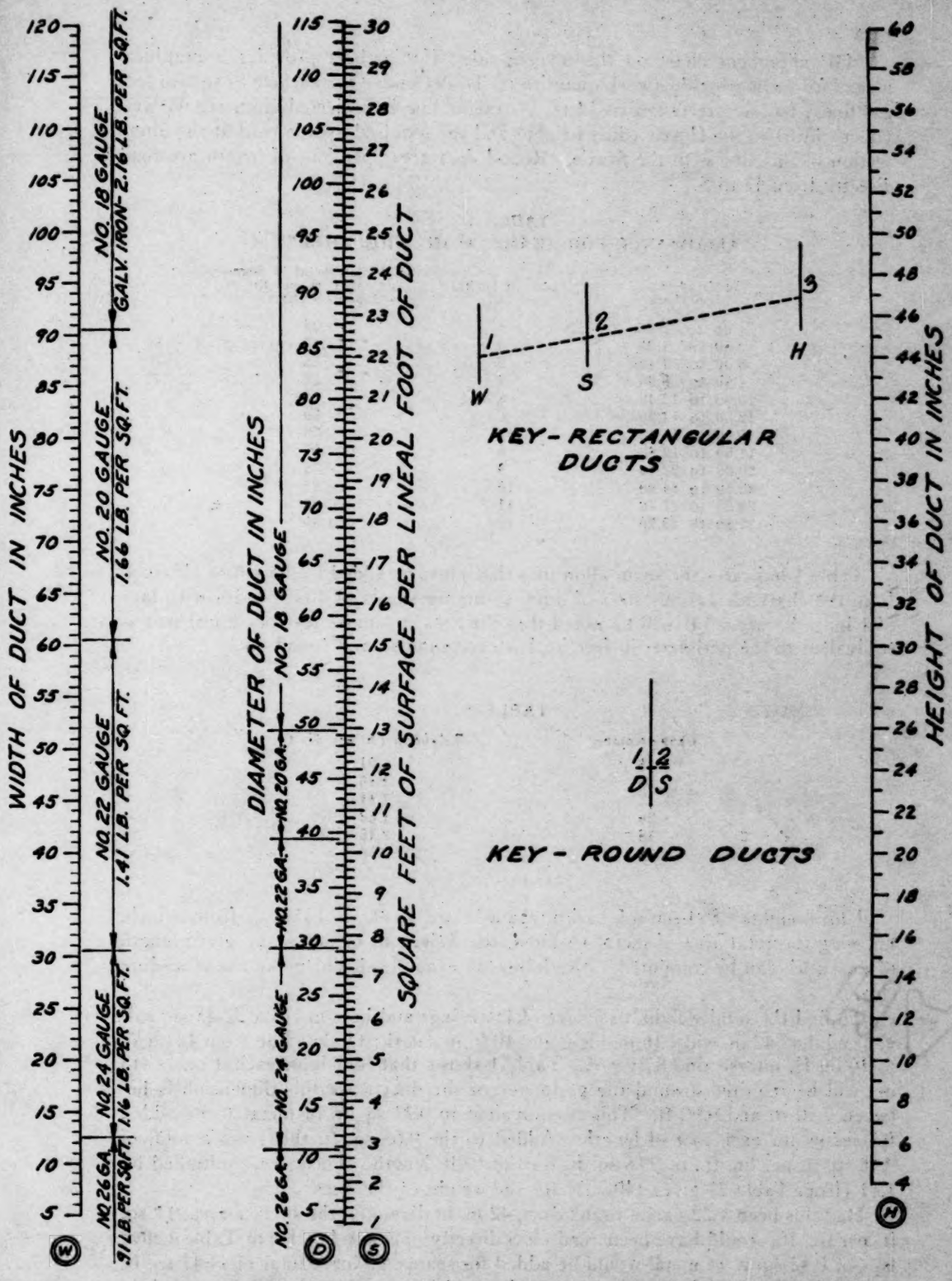
Because of this he argues that more attention should be given to the chemical content of spray water than has been given in the past. He advocates control of the content by controlled use of alkaline substances to be introduced into the water. No details of methods of application or of the exact chemicals for use are included.

[*Title: "Corrosion as Related to Air Conditioning Equipment," by R. M. Palmer. Presented at the A.S.H.V.E. annual meeting, January,* 1933; *approximately* 2500 *words, unillustrated.*]

ESTIMATING DUCTWORK

Areas and Weights of Round and Rectangular Galvanized Steel Ducts per Foot of Length

(SEE REVERSE SIDE FOR EXPLANATION)


WIDTH OF DUCT IN INCHES
NO 26 GA. .91 LB. PER SQ. FT.
NO 24 GAUGE 1.16 LB. PER SQ. FT.
NO 22 GAUGE 1.41 LB. PER SQ. FT.
NO. 20 GAUGE 1.66 LB. PER SQ. FT.
NO. 18 GAUGE GALV. IRON-2.76 LB. PER SQ. FT.
DIAMETER OF DUCT IN INCHES
NO. 26 GA.
NO 24 GAUGE
NO 22 GA.
NO 20 GA.
NO. 18 GAUGE
SQUARE FEET OF SURFACE PER LINEAL FOOT OF DUCT
HEIGHT OF DUCT IN INCHES
W
D
S
H
KEY - RECTANGULAR DUCTS
KEY - ROUND DUCTS

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H. & V.'s REFERENCE DATA—9

ESTIMATING DUCTWORK

Areas and Weights of Round and Rectangular Galvanized Steel Ducts per Foot of Length

(SEE REVERSE SIDE FOR EXPLANATION)

THE alignment chart on the reverse side of this sheet provides a graphical means for estimating ductwork quantities. To determine the surface in square feet per lineal foot for rectangular ducts, a straight line is projected from the W axis (duct width) to the H axis (duct height) and the required area is read at the intersection of this line with the S axis. Round duct areas per foot of length are read directly from D to S.

TABLE 1
ALLOWANCE FOR SEAMS, 30 IN. WIDE SHEETS

Sq. Ft. of Surface from Chart	Lap, in Inches	Sq. Ft. of Metal in Seams (Add to sq. ft. per lin. ft. found on chart)
up to 2.42	1	.08
2.50 to 4.92	2	.17
5.00 to 7.42	3	.25
7.50 to 9.90	4	.33
10.00 to 12.40	5	.42
12.50 to 14.90	6	.50
15.00 to 17.40	7	.58
17.50 to 19.90	8	.67
20.00 to 22.40	9	.75
22.50 to 24.90	10	.83
25.00 to 27.40	11	.92
27.50 to 29.90	12	1.00

Table 1 indicates the seam allowance that must be added to the figure obtained from the chart for various sizes of duct, assuming sheets of 30-in. width with laps of 1 in. to be used. It will be noted that the area in square feet per lineal foot is equivalent to the perimeter in feet for both rectangular and round ducts.

TABLE 2

Gauge Number	Weight in Lb. per Sq. Ft.
26	.91
24	1.16
22	1.41
20	1.66
18	2.16
16	2.66

Unit weights of sheets of various gauges are given in Table 2, from which, knowing the total area of metal required, the weight of metal in any given length of ductwork can be computed. The following example should make the procedure clear:

To find the total weight, exclusive of fastenings and bracing, of a 22-gauge galvanized duct 42 in. wide, 16 in. high, and 10 ft. in length: Draw a line from 42 on W to 16 on H, intersecting S at 9.65. Table 1 shows that four laps, each 1 in. $\times$ 12 in., will be required around the perimeter of the duct since this dimension is between 7.50 ft. and 9.90 ft. This is equivalent to 0.33 sq. ft. of metal to be added for seams for each foot of length. Added to the 9.65 sq. ft. this gives a total of 9.98 sq. ft. per lin. ft., or 99.8 sq. ft. for the 10-ft. length. This area, multiplied by 1.41 (from Table 2) gives 140.7 lb. for the weight of the duct.

Had this been a 22-gauge round duct, 42 in. in diameter, the surface area, 11 sq. ft. per lin. ft., would have been read on S directly opposite D. From Table 1, five laps or 0.42 sq. ft. of metal would be added for seams, giving a total of 11.42 sq. ft. per lin. ft. The weight of metal required would be $10 \times 11.42 \times 1.41 = 161$ lb.

Your Everyday Problems

HEATING AND VENTILATING will be glad to answer your problems relating to installation and operation of heating and ventilating systems. Letters will be answered promptly, and in some cases published anonymously. If sketches are included they should be clearly drawn. Write The Editor, HEATING AND VENTILATING, 148 Lafayette Street, New York.

QUESTION 82. *Is carbon dioxide injurious when breathed into the lungs?* *P. M. M.*

ANSWER. Carbon dioxide is present as a natural constituent in the purest of air, there being approximately three or four parts of CO_2 per 10,000 parts of air, by volume. This gas is not in any way poisonous and is quite harmless of itself when breathed, excepting when present in the air in sufficient quantity to appreciably dilute the oxygen, in which case the respiratory action is accelerated to compensate for the reduced oxygen. If an atmosphere containing more than 10% of CO_2 is breathed, loss of consciousness is likely to result, but no immediate danger of death exists, and no harmful after-effects will be felt.

●

QUESTION 83. *I sometimes hear thermostatic radiator traps on vacuum heating systems vibrating or singing. The noise generally lasts for a few seconds or a minute only, recurring at more or less regular and frequent intervals. I have noticed that both the diaphragm type of trap and the bellows type of trap are subject to this, and that it can occur in systems having temperature control as well as in those without.*

What is the cause of this vibrating, and what can be done to prevent it? *F. H. W.*

ANSWER. Vibration in thermostatic radiator traps generally occurs when the absolute pressure on the return side of the trap is equal to, or slightly in excess of, the absolute pressure within the radiator. When such a condition is present, there is a tendency for the thermostatic element to move slightly from close contact with the trap seat, and the least fluctuation in pressure will cause this valve to open and close rapidly, or "flutter." The vibration and noise may be amplified by a resonant effect produced by some part of the radiator or piping system having a similar or related vibration period.

This equalization of pressure on the two sides of the trap may result from several causes. If the vacuum is not sufficiently high and the radiator is exposed to a cold air stream, condensation may take place so rapidly as to reduce the pressure within it inducing a vacuum greater than that in the return. A leaking trap nearby in the same branch of the return system may permit enough steam to get into the return to exert a back pressure against the trap element, producing the same result. In this case, as the hot steam passes into the trap body and comes in contact with the thermostatic element, the trap will close instantaneously, opening again immediately to admit more steam from the return, and this rapid opening and closing of the trap will cause the element to beat rapidly against the seat. Then too, if the radiator valve is closed off, or nearly so, while the radiator is full of steam, the vacuum set up by the condensation may become equal to or greater than the vacuum in the return pipes, causing the fluttering of the element as the pressure becomes balanced.

Vibration in traps has sometimes been attributed to water, entrapped in pockets in the return lines, being drawn into the radiator through the trap, as a result of induced vacuum in the radiator. As the warm water enters the trap and the thermostatic element closes, the noise is produced as before.

To prevent the noise, obviously the offending trap, as well as all those on the same return, must be in good condition. The seats should be wiped clean with a rag saturated with kerosene, and thermostatic elements inspected and replaced if found defective. It is said that the slightly different operating characteristics of a new thermostatic element will often stop or greatly reduce the singing. Also, any measure that can be taken to insure the maintenance of a higher absolute pressure within the radiator than in the return lines, will correct the condition at its source. This can be done by increasing the vacuum, increasing the steam pressure, or perhaps by a more careful regulation of radiator valves, when control is manual.

●

QUESTION 84. *What is a Vanstone Flanged joint? What are its advantages, and where may it be applied?* *J. P. D.*

ANSWER: For this type of joint the flange is first bored to fit over the outside of the pipe loosely. The pipe is then rolled out or expanded ahead of the flange, to form a lap or flange in the pipe itself at right angles to its axis. This lap is faced on its front and outer edge, to form a bearing for the gasket. An improved Vanstone joint has the pipe strengthened at the turned-over portion by a band welded to the end of the pipe, and the turned-over portion is usually machined on its front, back, and outer surfaces.

The joint may be used with a flanged valve or fitting, as well as with two pieces of pipe. Advantages lie in its dependability and in the fact that no upkeep is required beyond occasional replacement of gasket. Since the flanges are loose and may be swiveled, the fittings, valves, etc., may be matched in any position.

News of the Month

Control of Smoke Nuisance Studied in Two Cities

Smoke from the chimneys of factories, office buildings, and homes may intercept as much as 50% of the sun's light in urban communities, according to the findings of a study made in Baltimore by the United States Public Health Service. A comparison of the average intensity of sunlight recorded on the roof of the city's police headquarters with that at a State sanitarium 10 miles out in the country, where there was little or no smoke, showed that about 14.1% less sunlight reached the earth in the city than in the country. The study further indicated that moisture in the air interferes with sunlight, since the average loss of light increased as the humidity increased. Wind reduces the loss of sunlight, presumably because it blows the smoke away.

Addressing representatives from the various boroughs lying outside Pittsburgh on a similar subject, H. B. Meller, director of the air pollution investigations of the Mellon Institute of Industrial Research, declared that the next logical development in the fight on atmospheric pollution must be the creation of air-hygiene districts which will control metropolitan smoke areas. Pointing out that Pittsburgh is surrounded by a number of factory communities that are beyond its jurisdiction, Mr. Meller stated that restoration to a state of purity of the air in the Pittsburgh area cannot be accomplished by a city ordinance alone. The city and the smaller boroughs exchange smoke, and each must cooperate to reduce the nuisance if general relief is to result.

Charter Granted to Bituminous Research, Inc.

A charter has been granted under the Delaware law to Bituminous Coal Research, Incorporated, the organization developed by the Research Committee of the National Coal Association, headed by John C. Cosgrove, Johnstown, Pa. Plans are taking form for the operation of the new enterprise, although it may require several months to get it under way. It is understood that technical research work will be conducted at Battelle Memorial Institute, Columbus, Ohio.

Nearly 175,000 Distillate Burners Made in 1932

Distillate oil burners, used for ranges, stoves, water heaters, and small heating plants, shipped in 1932 numbered 173,383, according to the Department of Commerce. The figures are based on reports from 39 manufacturers. Of the total shipped, 95% were of the perforated shell type, the remainder being of the vaporizing bowl type.

During February, 1933, 3,275 distillate burners were shipped, as compared with 9,878 in the same month of 1932.

Spencer Heater Opens Chicago Office

The Spencer Heater Co., Williamsport, Pa., recently opened central-west headquarters at Room 302, 180 North Wacker Drive, Chicago. J. A. Waddell has been placed in charge.

Second Warm Air Short Course Held at Michigan State

With an attendance of 50, representing seven states and Canada, the Second Forced Warm Air Short Course was conducted by the Mechanical Engineering Department, Michigan State College, East Lansing, Mich., March 28-30. This work was carried out under the supervision of Prof. Lorin G. Miller.

Phases of the subject considered on the opening day included "Standardized Design Methods," discussed by G. H. Voorhees, consulting engineer, Indianapolis; "Velocities and Temperatures at the Register," by J. H. Van Alsburg, Holland, Mich., and "Grate Areas, Heating Surfaces, and Baffling," covered by T. W. Torr, Dowagiac, Mich. The evening of the first day was devoted to laboratory demonstrations, conducted by Prof. W. E. Reuling, of Michigan State College.

S. H. Downs, Kalamazoo, Mich., opened the program of the second day with a lecture on fan characteristics, followed by a discussion of filters and washers by W. A. Rockafield, Kalamazoo. The subject of furnace controls was comprehensively covered by William F. Arnoldy and A. C. Grant, both of Minneapolis. The program of the final day comprised a lecture on humidification and the comfort zone, by Professor Miller; a discussion of types of equipment, by Tom Brown, Detroit, and a study of heat removal in cooling in which S. S. Sanford, Detroit, lectured on "Summer Comfort Cooling," and D. A. Newton, Detroit, outlined the engineering aspects of computing the cooling load.

Prof. H. S. Reed, of the Michigan faculty, officiated at the banquet held Wednesday evening at which Dean H. B. Dirks described the Hoover Dam project. A similar course of instruction is planned for next year.

Trane Appoints Mannion in Chicago

The Trane Co., La Crosse, Wis., has appointed Jerry Mannion as its distributor in the Chicago territory, with offices in the America Fore Building. With Mr. Mannion, who was sales manager of the Chicago Pump Company for the past 11 years, will be associated with C. J. McCann, formerly assistant sales manager of the Chicago Pump Company.

Locke New Vice-President of Dominion Radiator

D. H. Locke, vice-president and general manager of manufacturing of the American Radiator Company,

has been appointed vice-president and general manager of manufacturing of the Dominion Radiator & Boiler Co., Ltd., Toronto, the Canadian Division of the American Radiator and Standard Sanitary Corporation. He will also serve as a director.

Mr. Locke will retain his position with the American Radiator Company.

March Building Slightly Under February

Preliminary returns to Dun & Bradstreet, Inc., from 186 cities throughout the United States for the month of March show a total of $15,733,942 for building permits, a decline of 51.2% from March, 1932. The figure, however, is only slightly under the total for the identical cities during February, which was $15,933,279.

Rome Radiation Makes Appointments in South

Rome Radiation Co., Div. of Revere Copper and Brass, Inc., Rome, N. Y., has appointed W. C. Armistead, 207 Ninth Ave., N., Nashville, Tenn., as its sales representative for Tennessee, east of Jackson.

Frank J. Mueller, 1138 Connecticut Ave., N.W., Washington, D. C., has been appointed for the District of Columbia, and the northern portion of Virginia.

Bill in Congress to Curb Contract Abuses

A bill has been introduced in Congress by Representative Emanuel Celler, Brooklyn, which is intended to prevent defaults on Federal building projects by irresponsible low bidders, whose practice it has been to take government public works contracts under the "lowest responsible bidder" rule without due regard to cost and then defaulting after the first payment has been made, without paying for labor and materials and putting it up to the surety companies to carry out the work. Allen E. Beals, writing in the Dow Service Daily Building Reports, states that the measure has the sympathy of President Roosevelt and his cabinet, and predicts early passage.

The bill amends an act for the protection of persons furnishing material and labor for public works construction, and includes in its provisions that hereafter the obligations of the bond required upon any contract with the United States for the construction or repair of any public building or public work shall not be less than the total amount of the contract and that the funds received by a contractor in payment for such work are declared to be trust funds to be applied first to the payment of claims of subcontractors, architects, engineers, surveyors, laborers, and material men, and to the payment of premiums on surety bonds and insurance. Both general contractors and subcontractors violating this provision are guilty of larceny, and can be punished accordingly. General contractors and subcontractors will be required to maintain records of names and addresses of all persons, firms, or corporations making or receiving payments on account of the public improvement.

Mr. Beals attributes the sudden cessation of government contract letting to the government's desire to take advantage of the provisions of the pending bill.

COMING EVENTS

JUNE 6-8, 1933. National Warm Air Heating Association Convention, to be held in Chicago, Ill. Headquarters at the Stevens Hotel.

JUNE 12-17, 1933. Tenth Annual Convention of the American Oil Burner Association, to be held in Chicago. Headquarters at the Hotel Stevens.

JUNE 19-22, 1933. Fifty-First Annual Convention and Exposition of the National Association of Master Plumbers, to be held in New Orleans, La.

JUNE 22-24, 1933. Semi-Annual Meeting of the American Society of Heating and Ventilating Engineers, to be held in Detroit. Headquarters at the Hotel Statler.

JUNE 25-30, 1933. Sixth Midwest Engineering and Power Exposition, to be held in Chicago.

JUNE 27-30, 1933. Twenty-Fourth Annual Convention of the National District Heating Association, to be held in Chicago. Headquarters at the Palmer House.

JULY 25-28, 1933. Annual Convention of the Heating and Piping Contractors National Association, to be held in Chicago.

SEPTEMBER 25-29, 1933. Fifteenth Annual Convention of the American Gas Association, to be held in Chicago.

Patterson-Kelley Appoints Haydn Myer

Patterson-Kelley Co., New York, has appointed Haydn Myer, Comer Building, Birmingham, Ala., as its representative for the state of Alabama.

Crane Plans Campaign to Increase Sales to Industry

Two mailing pieces, "Born of Retrenchment" and "After Three Years of Starvation Maintenance," have been prepared by Crane Co., 836 South Michigan Ave., Chicago, for distribution to manufacturing concerns as a part of a campaign to stimulate industrial equipment sales. The first of these booklets discusses the wastes arising from inadequate repair, maintenance, and replacement, and points to the savings that can accrue from the application of new methods, designs, and materials. The second mailing explains a practical method by which to determine whether or not the piping equipment of a plant is efficient and modern, and provides a guide for achieving economies in maintenance work.

Jaros and Adlam Talk on Radiant Heating

Radiant heating received the attention of about 50 members and guests of the New York Chapter, A.S.H.V.E., at its regular dinner meeting, April 17, at the Building Trades Club. Speakers were T. Napier Adlam, engineer, Sarco Company, and Alfred L. Jaros, consulting engineer, New York.

Mr. Adlam traced the develop-

ment of panel heating in England, where it has been in use for more than a quarter of a century, outlining the fundamental theory involved, and describing the several methods used.

Mr. Jaros' discourse opened with a brief review of the principles involved, followed by a description of two American installations. These were illustrated by a film showing the details of the systems from the fabrication of the coils in the factory to their installation in the ceilings and walls. The speaker called attention to the architectural and decorative possibilities which exist where no limitations are imposed by exposed convection heating equipment. The cost of maintaining comfortable conditions is slightly over half the cost of heating with direct steam radiation, according to Mr. Jaros, who claims that installation cost is only about 15% higher for panel heating. Considerable discussion followed both talks.

Sinker-Davis Purchases Fire-King Stoker Co.

The Sinker-Davis Co., 230 South Missouri St., Indianapolis, announces the purchase of the Fire-King Stoker Company. Fire-King stokers will continue to be manufactured in the plant of Sinker-Davis, where its manufacture was originally begun in 1925. Distribution will be made direct to dealers.

A complete new line of Fire-King models, starting with three small sizes suitable for domestic purposes and completing the line with the larger sizes of industrial stokers, has been announced.

Ashley Opens Engineering Office

Edward E. Ashley, consulting engineer, announces the opening of offices at 10 East 40th St., New York, for the general practice of mechanical, electrical, and sanitary engineering, including air conditioning, elevators, Diesel and power plant equipment, and modernization.

Gas Consumption up 50% in 4 Years

According to Paul Ryan, statistician of the American Gas Association, the sale of manufactured gas for house-heating, as reported by identical companies, amounted to 14,260,900,000 cu. ft. in 1929, and increased to 21,640,100,000 in 1932, an increase of over 50%.

Roughly correcting the figures year by year for the variation in degree days per season, gas consumption for house-heating showed a steady increase almost directly proportional to the increase in number of installations. In 1932, however, the corrected gas consumption increased only slightly, while the number of customers increased 10% from the preceding year, apparently indicating that homeowners may be more carefully operating their gas systems, using fuel only when absolutely necessary.

Minneapolis-Honeywell Moves Chicago Office

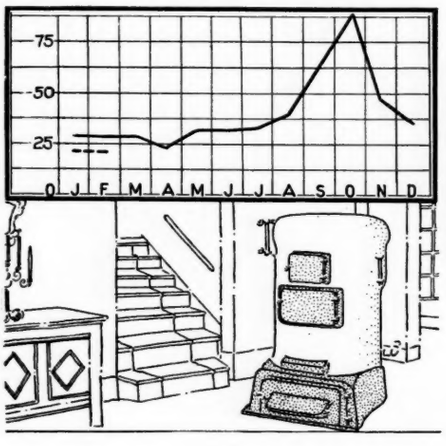
The Minneapolis-Honeywell Regulator Company has moved its Chicago office from the Daily News Building to 43 East Ohio Street.

Canadian Firm to Manufacture B & G Products

Bell & Gossett Co., 3000 Wallace St., Chicago, has licensed the Riley Engineering & Supply Co., Ltd., Miranda & Schell Aves., Toronto, Ont., Canada, to manufacture under its patents and trade marks, and distribute its products exclusively throughout the Dominion of Canada.

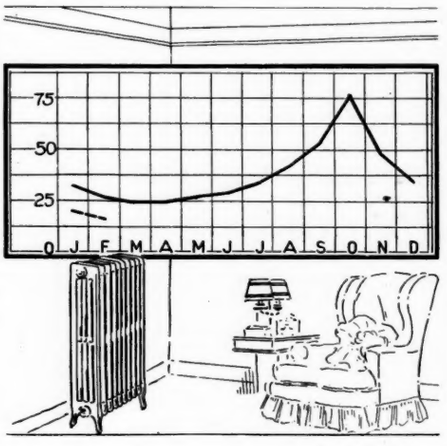
Michigan Chapter to be Host to A.S.H.V.E. for Semi-Annual Meeting

Technical discussions of interest and value, and a number of enjoyable divertissements are offered by the program planned for the semi-annual meeting of the A.S.H.V.E., scheduled to take place at the Hotel

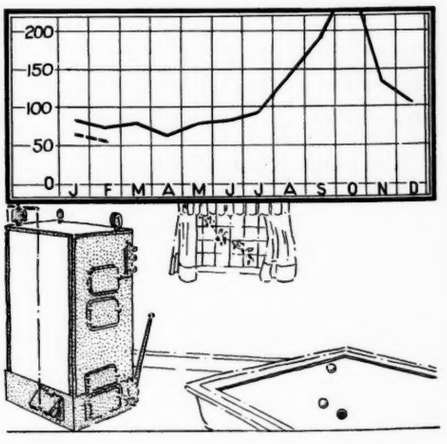


Solid Lines—1932

Shipments of Cast-Iron Round Boilers (Thousands of Pounds) February, 1933, 2133; February, 1932, 2857; decrease, 25.3%



Shipments of Cast-Iron Radiators (Thousands of Square Feet) February, 1933, 1634; February, 1932, 2683; decrease, 39%.



Dotted Lines—1933

Shipments of Cast-Iron Square Boilers (Thousands of Pounds) February, 1933, 5567; February, 1932, 7300; decrease, 23.8%.

Statler, Detroit, June 22-24. The Michigan Chapter will be in charge of arrangements, under the chairmanship of L. L. McConachie. Mornings will be devoted to business and technical sessions, with afternoons and evenings free for various entertainment features, many of which have been planned with consideration for the women guests.

Subjects to be under discussion at the technical sessions include Heat Dissipation from Insulated Hot Water Pipes, Test Results on the Conductivity of Different Grades of Lumber, Measurement of Air Flow through Grilles, Heat Output from Concealed Radiators, and Air Stratification in Assembly Halls, as well as data from the society's research laboratory.

Offner Moves

Alfred J. Offner, consulting engineer, formerly located at 1182 Broadway, New York, has moved his offices to 139 East 53rd St., New York.

H. & P. C. N. A. Move to Rockefeller Center

The Heating and Piping Contractors National Association, which recently leased office space on the 14th floor of the R.C.A. Building in Rockefeller Center, New York, moved into its new headquarters May 1. The association was formerly located at 50 Union Square, New York.

Hotel Ice Water System Cools Dining Room

Cold water from a central ice water circulating system is used in the finned cooling coils of three concealed cabinet-type air conditioners for summer cooling and dehumidification in the main dining room of the Fort Shelby Hotel, Detroit. The water is drawn from the reserve tank of the refrigerated water system, and passed through the coolers in a closed circuit returning to the water cooler with its potability unimpaired.

During the summer the water enters the conditioners at a temperature of between 40° and 45°. The dry bulb temperature is reduced a few degrees below the outside temperature, and a wide reduction in relative humidity resulting from the passage of air over the coils brings about a comfortable condition in the dining room. Conditioners are of the year 'round type, hot water being circulated during the heating season. The management reports that not only was the patronage of the dining room markedly increased through the installation of the comfort cooling equipment, but also the size of the meals ordered increased to a noticeable extent.

Construction Industry Plans Conference on Home Building

Believing the time to be propitious for instituting home building programs in all parts of the country, leaders in the construction and allied industries are sponsoring a National Conference on the Renewal of Home Building, to meet at the Congress Hotel, Chicago, May 9-10. The program is being planned with a view to fostering public confidence in the matter of home ownership in order to supply stimulus to this long dormant industry. A national survey of the housing situation is being prepared for the conference by the Department of Commerce, through the Division of Building and Housing, and it is expected that this survey will show a marked diminishing of vacancies.

Innovations in materials, equipment, processes, and planning, as well as new developments in home financing will be under consideration at the conference. Home equipment interests are represented on the committee on arrangements by Russell Creviston, Crane Company; Charles K. Foster, American Radiator Company; C. J. Bassler, Air Conditioning Corporation; N. G. Symonds, Westinghouse Electric & Manufacturing Company; H. J. Thorkelson, Kohler Company, and Dr. A. P. Haake, managing director, National Association of Furnace Manufacturers. J. Soule Waterfield, Starrett Building Company, is chairman, and Norman J. Radder, of the Plumbing and Heating Industries Bureau, is serving on the committee on publicity.

News of the Month

New York Engineers Protected by New Laws

Four bills affecting the status of architects and engineers and their relationships with the public recently became law in New York State. Included was a measure amending the multiple-dwelling law so as to restore the legal right of licensed professional engineers to file plans for multiple dwellings and any other buildings or structures.

Another measure revises two sections of the engineers' licensing law to protect the public by preventing evasions of the professional practice statutes. A third law sets forth the requirements to be met by both architects and engineers in obtaining a license to practice. The remaining measure enables the engineers' board to recommend revocation, suspension, or annulment of license, or reprimanding, censoring, or otherwise disciplining licensed engineers violating proper professional conduct.

General Offices of McIlvaine Moved to Chicago

McIlvaine Burner Corporation, has moved its general offices from Evanston, Ill., to 663 West Washington Blvd., Chicago. The company's dealer training school and engineering department will also be transferred to the new offices.

New Rudy Furnace Officers Named

The Rudy Furnace Co., Dowagiac, Mich., announces new company officers, as follows: Arthur F. Frazee, vice-president and general manager; Leo J. Biek, secretary and assistant sales manager, and Sidney B. Tremble, treasurer and advertising manager. Mr. Frazee

News of the Month

was formerly secretary and advertising manager. Mr. Biek and Mr. Tremble were also elected directors.

Boilers for Burning Oil

It has been called to our attention that the line of Wickes L-O heating boilers, manufactured by The Wickes Boiler Co., Heating Div., Saginaw, Mich., was omitted from the list of boilers for oil burning, published in HEATING AND VENTILATING for April. These are horizontal boilers of the self-contained fire-box type, combining fire- and water-tubes, of welded steel construction. Series 5, with front-end chimney connection is built in 18 sizes, ranging in capacity from 3876 sq. ft. to 39,559 sq. ft. of steam radiation. Series 4, rear chimney connection, 18 sizes, 3876 sq. ft. to 39,168 sq. ft. of steam radiation. Ratings are in accordance with Steel Heating Boiler Institute.

Jones Visits Illinois Chapter

At the regular dinner meeting, held April 10 at the Sherman Hotel, Chicago, 48 members and guests of the Illinois Chapter, A.S.H.V.E., greeted W. T. Jones, national president, and heard his address, "The Status Quo of Our Society." Mr. Jones outlined the work of the society, pointing out the benefits accruing to members, and mentioning the services it performs.

Mr. Jones had previously addressed the Michigan chapter at its regular monthly meeting, April 6, held at the Detroit-Leland Hotel, Detroit, where he discussed society activities and the financial condition of the society.

Ottinger Establishes Humidity Headquarters

Establishment of Humidity Headquarters, 1929 East 55th St., Cleveland, manufacturing and marketing fittings for humidifying and air-washing apparatus, has been announced by Walter J. Ottinger, who directs the business. Present products include the Kwiklock for tapping into water supply, the Kwikturn angle valve for regulating flow of water or gas, and the Kwikleen filter for protecting small fluid valves and orifices. The line is being extended to include larger fittings for small air washer applications.

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25 Years Ago in

The Heating Ventilating Magazine

MAY, 1908

NEW WORKING RULES for steamfitters in Pittsburgh were formulated giving them $2.75 to $4 per day, to be paid every two weeks.

BUILDING OPERATIONS in March showed a decrease in each section, except the South, over the figures for the corresponding period for 1907. In the Eastern cities, the decrease was 58%; Middle West, decrease 25%; Southern increase 54%; and Pacific Coast, decrease 42%. In New York the figures fell from $15,723,818 to $4,782,090.

KONRAD MEIER, New York, heating and ventilating engineer, announces the removal of his office to 122 East 25th St.

H. W. JOHNS-MANVILLE CO.'S business interests in Detroit and the territory adjacent thereto, have increased to such an extent that a new branch is about to be opened by that company. This branch will be located at 72 Jefferson Ave., Detroit, under the management of Willard K. Bush.

ST. PAUL, MINN. After an inspection of the State Normal School building at Mankato by the local fire investigating committee, the committee recommended that a number of wooden air ducts extending from the basement to the top of the building be removed, and that a separate building for the heating plant for the entire school be constructed.

STUART W. CRAMER CO., Charlotte, N. C., incorporated for $100,000, to manufacture air moisteners and ventilating apparatus. Incorporators, Stuart W. Cramer, John T. Cramer, and others.

H.B. GOMBERS SECY. OF THE NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS AT THE CONVENTION

H. B. GOMBERS, secretary of the National Association of Master Steam and Hot Water Fitters since 1897, was elected to an additional office, that of recording secretary of the New York State Association of Master Steam and Hot Water Fitters at the State Convention in Syracuse.

Charles J. Biek

Charles J. Biek, vice-president and general manager of the Rudy Furnace Co., Dowagiac, Mich., died suddenly March 24 from a heart attack.

Born in Dowagiac August 1, 1891, Mr. Biek entered the heating business at an early age and became associated with the Rudy Furnace Company. After the death of Mr. Rudolphi, he became vice-president and general manager. He was also vice-president of the Dowagiac National Bank, vice-president of the Rudy Acceptance Corporation, and a director of the Judd Lumber Company.

He is survived by his widow and two children.

NEW CATALOGS

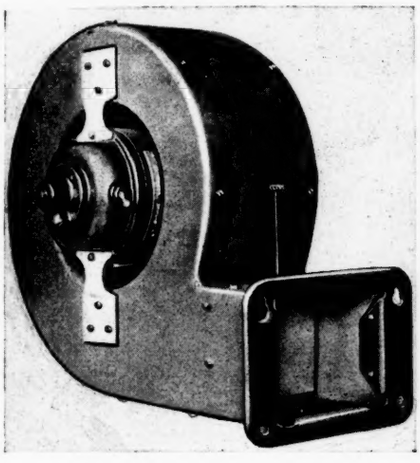
J. H. McCormick & Co., Williamsport, Pa., has issued a series of bulletins for distribution among dealers and prospective dealers of Airtrol air conditioning equipment. Air conditioning theory and principles are set forth, apparatus described and illustrated, and instructions given for surveying the air conditioning needs of a prospective purchaser. Standard size, 22 pages, punched for looseleaf binding.

Taylor Forge & Pipe Works, P. O. Box 485, Chicago, has published "Designed Piping," a paper on pipe welding presented before a joint meeting of the A. W. S. and the Petroleum and Power Division, A.S.M.E., by F. S. G. Williams; standard size, 7 pages.

New Equipment

Forced Draft Unit for Domestic Heaters

A forced draft blower unit for use with domestic furnaces and boilers has been placed on the market by the National Radiator Corp., Johnstown, Pa. Fan is fully enclosed in a dustproof housing. The motor,



National forced draft unit

which draws 42 watts, is slow starting, giving no sudden blast to cause clinkering and raise dust. An adjustable draft gate permits regulation of the maximum opening to suit the conditions of combustion. This gate automatically closes when the fan is stopped. Operation of the blower is controlled by a thermostat which is furnished with the equipment, and on boilers equipped with a regulator, the fan can be arranged to cut out when the boiler water reaches a certain temperature, independently of the thermostat. The unit delivers 75 c.f.m.

Device Demonstrates Presence of Dust in Air

An air sampling unit to be used by salesmen and demonstrators of air conditioning equipment for producing convincing evidence as to the amount of dust and dirt in suspension in indoor air, has been introduced by The Peerless Electric Co., Warren, Ohio. A compact cabinet houses a small motor and blower which draws room air in through a grilled outlet, passes it through a filter, and discharges it back into the room.

A stencil of any suitable material is placed over the filter material on the intake side, and at the completion of a day's run in an average room the design on the stencil shows up in black the dirt removed from the air by the filter. The unit is provided with a handle at the top for carrying, and an extension cord for attaching to any convenient electrical outlet.

Combination Heating System and Water Heater

A combination house and indirect domestic hot water heating system for summer-winter operation, designed for use with an automatically-fired hot water boiler, has been announced by The Stevens-Root Co., 51 East Grand Ave., Chicago.

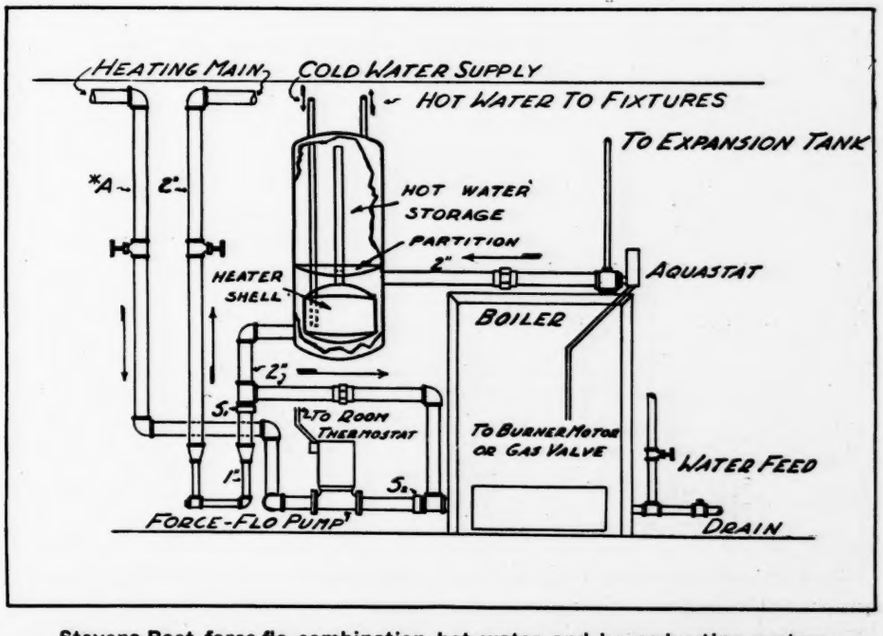
Boiler water is maintained continuously at a temperature of from 130° to 180° by aquastat control for heating the domestic hot water. Water returning from the indirect heater is by-passed back to the boiler by the shunt S_1, which directs the flow by gravity when the thermostatically-controlled circulator is not in operation. The shunt S_2 prevents back-up into the circulator, and no circulation through the house-heating system takes place when the pump is not operating.

The indirect storage hot water heater used with the Force-Flo combination system is in effect an inner shell enclosed in a tank. Cold water enters through a pipe passing through the storage compartment, and is heated in the inner shell to a temperature approaching that of the boiler water in which the shell is immersed. From the shell the water rises to the storage tank, which is partitioned off from the lower compartment.

Unit Cooling and Washing Unit

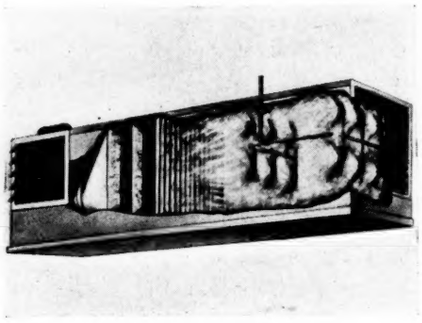
King Ventilating Co., Owatonna, Minn., is marketing a unit system for cooling, washing, and humidifying air in stores, restaurants, offices, and homes.

A squirrel-cage blower, driven by a rubber-mounted motor through a V-belt, provides the circulation. Air is drawn into the spray chamber and passes through baffle plates where excess moisture is removed before entering the blower housing



Stevens-Root force-flo combination hot water and house-heating system

from which it is discharged back into the rooms. Spray nozzles are solid brass and are of centrifugal type, designed with large-sized



King horizontal cooling and humidifying unit

openings to provide a fine uniform spray with low power consumption. Water for cooling is supplied from an ice tank, mechanical refrigerating unit, or other satisfactory source of cold water. A copper mesh strainer is installed in the recirculating pipe to remove dirt and foreign matter from the water. Blower can be run independently of the water sprays for air circulation alone if desired, and water at room temperature may be used for washing and humidifying when cooling is not desired. Automatic control may be applied.

Units are available in ¾ ton and 1½ ton capacities in the vertical type, and in 1½, 3, and 5 ton capacities in the horizontal type, the discharge ranging from 450 c.f.m. to 4000 c.f.m. of air.

Mechanical Control for Water Heater

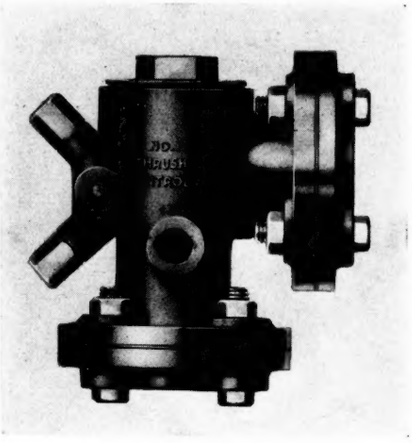
Automatic oil-burning domestic water heaters, manufactured by Motor Wheel Corp., Lansing, Mich., are now equipped with a thermostatically-operated mechanical snap-action temperature control. An oil pilot ignites the units, and use of the control makes their operation entirely independent of the availability of electric power or gas.

A drop in the temperature of the water in the heater boiler causes a contraction of a vapor-filled thermostatic bellows which moves to throw the oil control to the "on" position. As the bellows expands with a rising temperature, the control is snapped off at a predetermined point. A small knurled knob on the thermostat enables adjustment of the temperature to be easily made.

Valve Supplies Instantaneous Hot Water to Radiators

Installed in conjunction with the Thrush water circulator, the No. 120 flow control valve, recently announced by H. A. Thrush & Co., Peru, Ind., provides for instantaneous response of radiators to heat demand, prevents overheating, and insures satisfactory operation of an auxiliary hot water supply system.

Boiler temperature is maintained



Thrush flow control valve

by submerged control at from 180° to 220°, and the room thermostat controls the operation of the circulator only. While the circulator is not in operation, circulation of hot water from the boiler is positively cut off by the flow control valve, preventing heat waste and overheating. When the thermostat calls for heat, the circulator cuts in and the valve opens, supplying hot water from the boiler immediately to the radiators. Since a limited amount of water is contained in the boiler, but little heat is required to maintain the boiler temperature during periods when circulation is cut off.

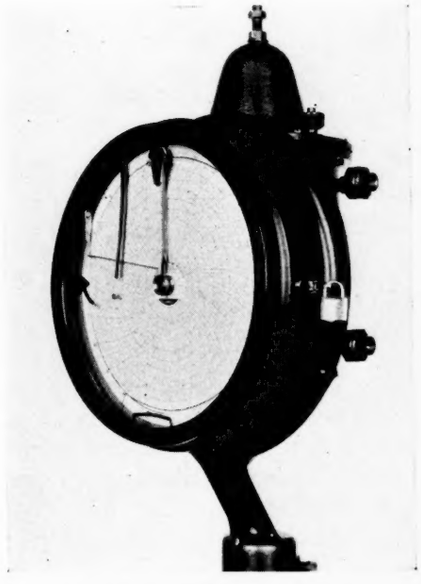
This system may be applied with gas, oil, or stoker-fired boilers, or when hand-firing is used. The circulation to the radiators may be completely cut off during the summer by turning a set screw to permit operation of the equipment to supply hot water for domestic use.

Meter Records Fan Discharge

Designed to accurately record the flow of gas at low pressure, the Bell-Type meter, a product of The Foxboro Co., Foxboro, Mass., is recommended by the manufacturer for metering fan and blower discharge, manufactured gas distribution, and similar applications. This instrument can be furnished with any of the standard primary metering devices such as the orifice plate, pitot tube, flow nozzle, or venturi tube, rendering it available for use wherever pressure loss must be minimized.

Pressure differential is measured by a bell-shaped piston, spring balanced, which is subjected to the upstream pressure on its exterior and to the downstream pressure on its interior. The motion is converted to flow readings on the chart through a segmental lever and chain linkage which operates the pen arm without friction or lost motion. A small quantity of mercury in the lower part of the meter chamber forms a seal between the interior and exterior sides of the bell piston.

Gas flows as high as 1,000,000 cu. ft. per hr. can be recorded on a single meter, and instruments having ranges of 2.5 in., 5 in., and 10



Foxboro Bell-Type meter

in. of water differential can be furnished. An eight-page, standard size bulletin describing the meter in detail may be had by addressing the manufacturer.

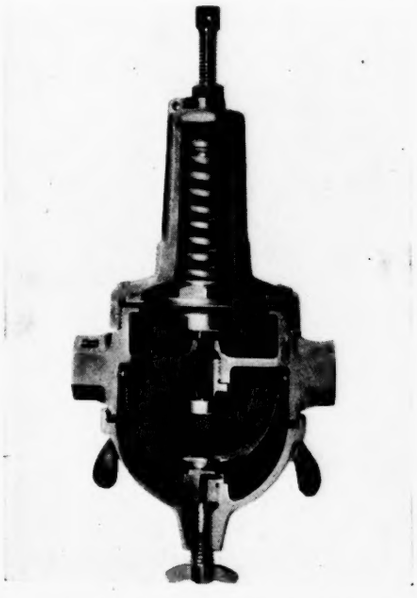
Portable Humidifier and Air Washer

Murray & Nickell Mfg. Co., Air Conditioning Div., 307 North Michigan Ave., Chicago, is marketing the Murnick portable air washer and humidifier. Room air is drawn into the case by a small motor-driven fan and circulated past seven staggered moist fabric baffles. During the warm months ice can be charged into the unit instead of water for comfort cooling, it is claimed.

Regulator Delivers Water at Constant Pressure

Pittsburgh Equitable Meter Co., Pittsburgh, Pa., is manufacturing the Emco combination water pressure regulator and strainer for maintaining constant pressure flow where the pressure of the supply fluctuates. The manufacturer recommends it for air conditioning apparatus and similar applications.

Valve is spring-balanced, and an adjustment screw at the top of the regulator permits variation of the tension of the spring. The unit will reduce line pressures up to 150 lb. per sq. in. to any desired pressure within a range of from 5 lb. to 40 lb. Strainer is fabricated from perforated monel metal. It can be cleaned by loosening the four wing nuts which hold the strainer cup in place and removing it, without taking the main casing off the water line. Available with ⅛, ¼, and ⅜ in. connections.

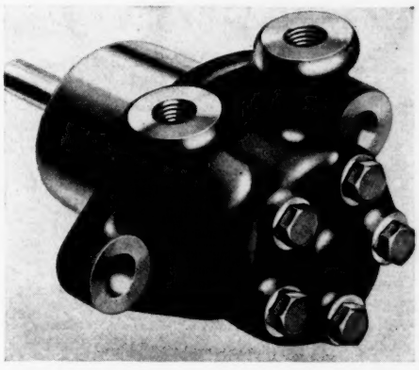


Emco water pressure regulator

Oil Burner Pump with Rolling Action

Sundstrand Machine Tool Co., Pump Division, Rockford, Ill., is manufacturing the Rota-Roll pump for oil burners. It can be supplied with either flange or foot type of mounting.

Pumping members consist of a roller and rotor which revolve with each other in a manner similar to that of a roller and the outer race of a roller bearing. Positive contact between the roller and rotor constitutes a rotating seal, and the oil is emptied ahead of the seal through the outlet port. The device is hydraulically balanced and self-emptying, eliminating back-surge and providing a positive uniform flow. The rolling action assures frictionless, noiseless, and long-wearing operation.

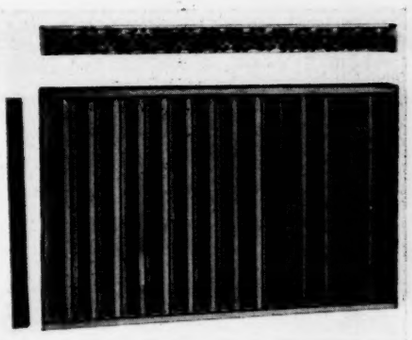


Sundstrand Rota-Roll oil pump

At a speed of 1800 r.p.m. the pump has a capacity of 20 gal. per hour, against a pressure of 100 lb. It is driven direct at motor speed.

Air Cleaner Entraps Dust and Grime

W. R. Ripley Co., 303 Bernice Building, Tacoma, Wash., is marketing the Interceptic air cleaner for domestic and industrial applications. The filter is constructed of multiple wooden spacers into which spiral oil reservoir pockets have been cut to present a large surface



Interceptic air cleaner

to the passing air. Soot, dust, and grime carried in the air are caught and held by the oily surfaces.

Exceptionally low resistance to flow and long life are claimed by the manufacturer, who states that the filter can be reversed to add to its effective life. The oil used in the cleaner has an antiseptic quality which is said to destroy bacteria carried in the dust of the air. It is also said to be effective as a sound damper, reducing the noise of fans and motors as conveyed through the ducts. Filters are made in four sizes, having capacities to 1650 c.f.m. at ⅛ in static pressure.

Electric Valve for Humidity Control

Detroit Lubricator Co., Detroit, has announced the No. 640 electric water valve. Although developed primarily for humidity control, this appliance may be used for air, gas, oil, steam, and refrigerants not corrosive to brass.

Operation is controlled by the making and breaking of an electric circuit either by a thermostat or by control switches for temperature, pressure, or vacuum. When the circuit is closed, an electric heating element wound around a bulb filled with volatile liquid is energized. Pressure from the bulb is conveyed through a tube, expanding a metallic bellows which acts through a lever

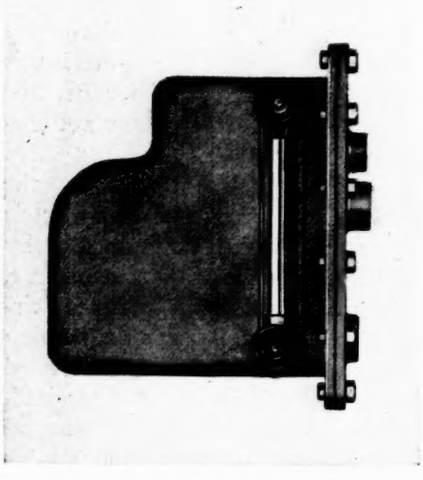
to open a needle type valve against a heavy spring. When the circuit is broken, the bulb is cooled, and the spring closes the valve, forcing the needle tightly against its seat.

Valve is regularly furnished with 3/32-in. orifice to open against 100 lb. maximum pressure, and larger orifices can be furnished to order. Inlet and outlet connections are ¼ in. The device is rated at 16 volts alternating current, and draws 6 watts at this potential. It will not be damaged when subjected continuously to 24 volts. No current is consumed when the valve is closed.

Return Trap for Vapor-Vacuum Systems

Hoffman Specialty Co., Waterbury, Conn., has announced a boiler return trap in four standard sizes for use with vapor-vacuum systems fired with oil, gas, or soft coal in which pressures generally are built up rapidly. It also has application in systems in which unit heaters or other appliances require a constant pressure in excess of 8 oz.

Balanced, double-seated valve mechanisms control the steam supply and exhaust ports, which are of large area to give rapid equalization of pressures when the steam valve opens. The receiver vent provides storage capacity for the condensate accumulating while the trap discharges to the boiler, which eliminates temporary flooding of the return, making it possible to operate the system with a minimum of water line differences. Air is vented through a valve on the receiver vent, which closes against its return to the system, permitting operation under partial vacuums. All seating surfaces and working parts are of non-corrosive metals, and are enclosed entirely within the trap. Exceptionally quiet operation is claimed.

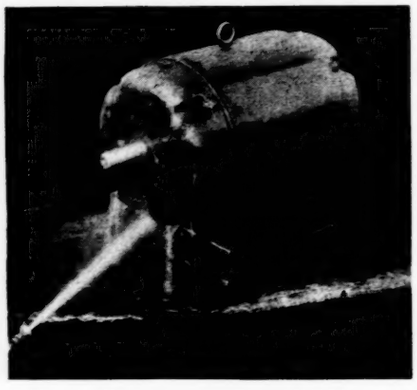


Hoffman boiler return trap

Ideal Splash-Proof Motor

Splash-proof motors, protected against damage by water splashed or sprayed upon them, have been announced by The Ideal Electric Co., Mansfield, Ohio. They are available as induction, capacitor, and across-the-line-start motors in all sizes from 1 hp. to 200 hp.

Baffles placed in the air ducts remove all spray from the air entering the motor and keep the windings dry. The manufacturer states that the motor gives all the protection of a totally-enclosed motor at considerably lower cost.

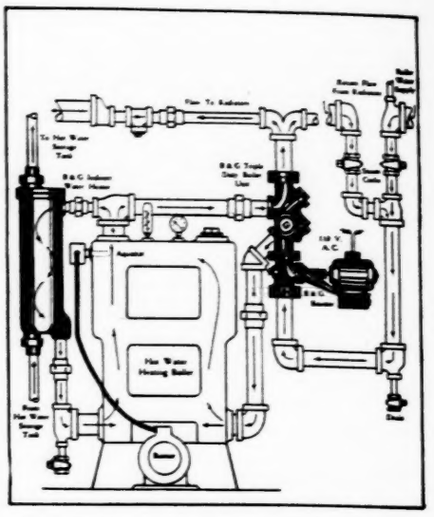


Splash-proof motor

Auxiliary System for Hot Water Heating Plants

Bell & Gossett Co., 3000 Wallace St., Chicago, has developed the B & G triple duty boiler unit system for providing controlled circulation in hot water heating plants permitting steady operation of an indirect water heater, and for accelerating the distribution of heat.

This equipment comprises a combination of an indirect water heater, a motor circulator, and a unit containing flow and return control valves. These valves may be either automatically opened and closed by the head created by the circulator, or they may be manually operated,



B & G triple duty boiler unit system

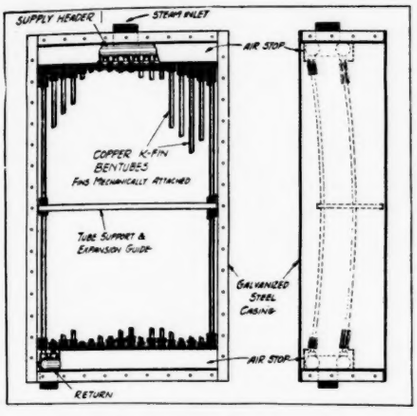
and they serve as check valves, closing off circulation to the radiators when no heat is required and preventing reverse boiler circulation. When the thermostat calls for heat the circulator starts, providing immediate circulation to the radiators. However, when the thermostat shuts the circulator down, gravity closes the valves, positively arresting circulation to the radiators, but permitting gravity circulation to the indirect heater to continue. For automatic operation, the thermostat normally controls only the operation of the circulator, and an aquastat in the boiler starts and stops the burner or stoker. Therefore, the water in the boiler is constantly hot during standby periods, ready to be circulated to meet a sudden demand.

Heating Surface Tubes Bent to Relieve Expansion Stresses

Hitchen Engineering Co., Inc., 155 East 44th St., New York, is marketing the K-Fin Bentube indirect heat transfer surface for heating and cooling, a recently announced product of The Griscom-Russell Co., 285 Madison Ave., New York.

Heating surface consists of either one or two rows of finned copper tubes brazed into cast bronze or brass headers at each end, and formed with an initial curvature to

compensate for expansion and contraction. The extended copper surface is applied helically by a process that combines both tension and pressure, assuring a permanent bond with positive contact between the edge of the fin and the tube. Steam



K-Fin Bentube heating surface

enters the tubes from the supply header through accurately drilled orifices somewhat smaller than the inside diameter of the tubes to give a uniform distribution. Steam connection is at the center of the supply header, and the return is taken from one end of the return header. Headers are supported firmly in place by a rigid galvanized sheet iron casing.

Tubes are 5/8 in. in diameter and may be supplied with fins 1 1/8 in., 1 3/8 in., or 1 7/16 in. outside diameter, spaced seven or eight to the inch, depending upon the duty. Maximum working pressure is 200 lb. per sq. in., and maximum working temperature is 388°.

Fan Type Electric Heater

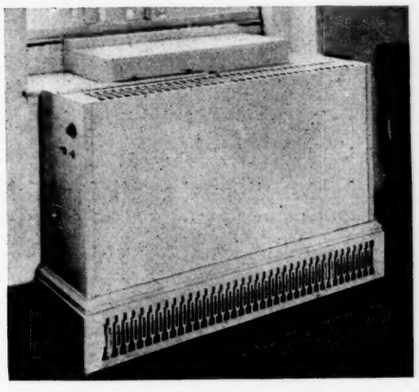
Hynes Electric Heating Co., 240 Cherry St., Philadelphia, is marketing the Hynes Type H.C.W. electric air heater in a series of four sizes, delivering from 180 c.f.m. to 1300 c.f.m. of warmed air.

A motor-driven fan draws air from the room into the casing and circulates it across the electric heating element, discharging it back into the room horizontally. Brackets for wall mounting are standard, but suspension brackets for ceiling mounting are available. The device is protected against overheating by a thermal fuse. Thermostatic control is recommended by the manufacturer, and for preventing condensation where comfort from uniform temperature is not essential, the Hynes dewpoint control may be used with the unit.

Complete Air Conditioning Unit Contained in a Single Cabinet

A direct cabinet-type unit, performing year 'round air conditioning functions, has been announced as a combined product of Campbell Metal Window Corp., Pershing Square Building, New York, and General Electric Co., Schenectady, N. Y. It is designated the Model C.

This unit is designed for installation in front of the window, and can replace an existing radiator. During the heating season the conditioner provides for circulation of cleaned and humidified air, warmed by a steam or hot water heat exchange



Campbell-General Electric Model C conditioner

surface within the unit. Summer cooling is accomplished by a mechanical refrigerating unit, completely contained in the cabinet along with the refrigerant condenser. Elimination of noise at all times is provided by an application of the Maxim-Silencer principle. A single conditioner will satisfactorily handle the requirements of one room of ordinary size.

A portable room cooler, which recirculates cooled and dehumidified air, is also being marketed by Campbell and General Electric.

Emerson Announces Line of 3 H. P. Motors

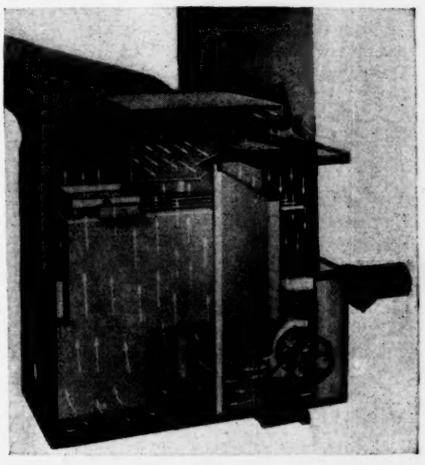
Emerson Electric Mfg. Co., St. Louis, has announced a line of 3-hp. motors, to be supplied in the single-phase repulsion start induction type, the polyphase squirrel cage type, and the compound-wound, direct current type. Rotors revolve on tool steel shafts running in wool-packed bronze bearings. A constant circulation of air through the motor is provided by vent openings in the frames and a fan on the shaft, and motors are designed to operate continuously without overheating. They are built to N.E.M.A. dimensions.

Oil-Burning Furnaces and Air Conditioning Units

A line of oil-burning gravity warm-air furnaces and forced circulation air conditioning units, comprising two sizes of each, is being marketed by The George Evans Corp., Moline, Ill.

Units are of one-piece construction, with drawer type removable firepot, allowing accurate dimensioning of lining to suit burner. Large radiating surface without vertical baffles or zig-zag passages, together with slot type lateral fire flues, promote rapid and effective heat absorption. The forced conditioned air units have fan, dry-type filters, and automatic pan type humidifier completely enclosed in one casing.

Oil burners of any standard manufacture or model can be used with the units. Capacities range from 1 gal. to 2 1/4 gal. of oil per hour.



Evansway air conditioning unit, cutaway view

Degree-Days for Season About Normal, but Above Last Year

March, 1933

(Percentages below indicate increase or decrease in degree days for this season compared with normal)

EAST	
New York	— 10 5%
Philadelphia	— 14.0
Boston	+ 6.9
Buffalo	— 7.3
Baltimore	— 12.0
Pittsburgh	— 4.3
MIDDLE WEST	
Chicago	— 3.3%
St. Louis	— 5.2
Kansas City	— 10.2
Minneapolis	— 0.3
Cincinnati	+ 0 2
Cleveland	— 11.5
Detroit	— 5 8
Indianapolis	— 2.1
Louisville	— 0.1
Des Moines	— 0.9
SOUTH	
New Orleans	+ 5 1%
Atlanta	— 4.1
Birmingham	0.0
Memphis	+ 2.0
FAR WEST	
Denver	+ 0.4%
Seattle	+ 0.5
San Francisco	+ 0.6
Los Angeles	— 11.1

TEMPERATURES for the month of March ran so close to normal that the degree-days for the various cities for the month show, on the whole, very close to normal figures. Addition of these monthly figures bring the totals for the present heating season more nearly in line with last season's totals, although the country as a whole, as shown in the column to the right, is still showing a greater number than last year. Totals for the present season are compared with normal totals in the column to the left.

For March, Boston shows exactly the same number of degree-days as accumulated in that month last year, while New York has one less than the normal for the month. Birmingham shows for the season exactly the same total as normal. Other cities running practically the same as normal are Minneapolis, Cincinnati, Louisville, Des Moines, Denver, San Francisco, and Seattle. As compared with last season, all but Seattle, San Francisco, and Los Angeles are showing higher seasonal totals this year. New Orleans figures reflect a 66.5% increase in fuel consumption as compared with last year.

Degree-days for March, and totals for this season, last season, and normal, together with fuel consumption data for March, are shown below.

(Percentages below indicate increase or decrease in degree days for this season compared with last year)

EAST	
New York	+ 12.2%
Philadelphia	+ 16.3
Boston	+ 2.5
Buffalo	+ 12.8
Baltimore	+ 21.5
Pittsburgh	+ 15.6
MIDDLE WEST	
Chicago	+ 18.9%
St. Louis	+ 23.6
Kansas City	+ 15.1
Minneapolis	+ 14.1
Cincinnati	+ 21.5
Cleveland	+ 9.8
Detroit	+ 17.0
Indianapolis	+ 21.4
Louisville	+ 24.3
Des Moines	+ 13.6
SOUTH	
New Orleans	+ 66.5
Atlanta	+ 32.2
Birmingham	+ 39.2
Memphis	+ 37.7
FAR WEST	
Denver	+ 2.0%
Seattle	— 1.6
San Francisco	— 11.1
Los Angeles	— 13.3

Degree-Days and Unit Fuel Consumption—March, 1933

	Atlanta	Baltimore	Birmingham	Boston	Buffalo†	Chicago	Cincinnati	Cleveland
Degree-days for March, 1933.....	400	683	342	910	1057	918	720	900
Degree-days, Sept. 1, 1932 to Mar. 31, 1933	2647	3663	2339	4478	5374	5311	4353	4767
Degree-days, Sept. 1, 1931 to Mar. 31, 1932	1987	3006	1680	4367	4763	4467	3583	4342
Degree-days, Sept. 1 to March 31, Normal	2759	4162	2339	4188	5799	5491	4344	5390
Lb. coal per sq. ft. rad., March, 1933....	3.200	5.464	2.736	7.280	8.456	7.344	5.760	7.200
Gal. oil per sq. ft. rad., March, 1933....	0.274	0.468	0.235	0.624	0.725	0.629	0.494	0.617
Cu. ft. gas per sq. ft. rad., March, 1933..	38.40	65.57	32.83	87.36	101.47	88.13	69.12	86.40

	Denver	Des Moines	Detroit	Indianapolis	Kansas City	Los Angeles	Louisville	Memphis
Degree-days for March, 1933.....	683	854	956	787	647	176	642	400
Degree-days, Sept. 1, 1932 to Mar. 31, 1933	5094	5770	5364	4753	4453	1116	3912	2911
Degree-days, Sept. 1, 1931 to Mar. 31, 1932	4992	5079	4585	3913	3869	1288	3148	2115
Degree-days, Sept. 1 to March 31, Normal	5072	5825	5695	4855	4966	1255	3916	2854
Lb. coal per sq. ft. rad., March, 1933....	5.464	6.832	7.648	6.296	5.176	1.408	5.136	3.200
Gal. oil per sq. ft. rad., March, 1933....	0.468	0.586	0.656	0.540	0.444	0.121	0.440	0.274
Cu. ft. gas per sq. ft. rad., March, 1933..	65.57	81.98	91.78	75.55	62.112	16.90	61.63	38.40

	Minneapolis‡	New Orleans	New York	Philadelphia	Pittsburgh	St. Louis	San Francisco	Seattle
Degree-days for March, 1933.....	1070	112	836	733	832	629	298	621
Degree-days, Sept. 1, 1932 to Mar. 31, 1933	7027	1075	4211	3772	4530	4085	2136	3953
Degree-days, Sept. 1, 1931 to Mar. 31, 1932	6161	646	3753	3243	3919	3305	2404	4019
Degree-days, Sept. 1 to March 31, Normal	7045	1023	4707	4385	4734	4309	2124	3932
Lb. coal per sq. ft. rad., March, 1933....	8.560	0.896	6.688	5.864	6.656	5.032	2.384	4.968
Gal. oil per sq. ft. rad., March, 1933....	0.734	0.077	0.573	0.503	0.571	0.431	0.204	0.426
Cu. ft. gas per sq. ft. rad., March, 1933..	102.72	10.75	80.26	70.37	79.87	60.38	28.61	59.62

†*Degree-days for Buffalo for February, 1933, were 1056, and not 991 as given on this page last month.*
‡*Degree-days for Minneapolis for February, 1933, were 1423, and not 1358 as given on this page last month.*

Fuel consumption figures given above are based on certain conditions, and for other conditions corrections must be made. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operating at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal, 1000 B.t.u. per cu. ft. for gas, and 140,000 B.t.u. per gal. for oil. To correct for other heating values, efficiencies, and design conditions, follow the method explained in the "Heating and Ventilating Degree Day Handbook."

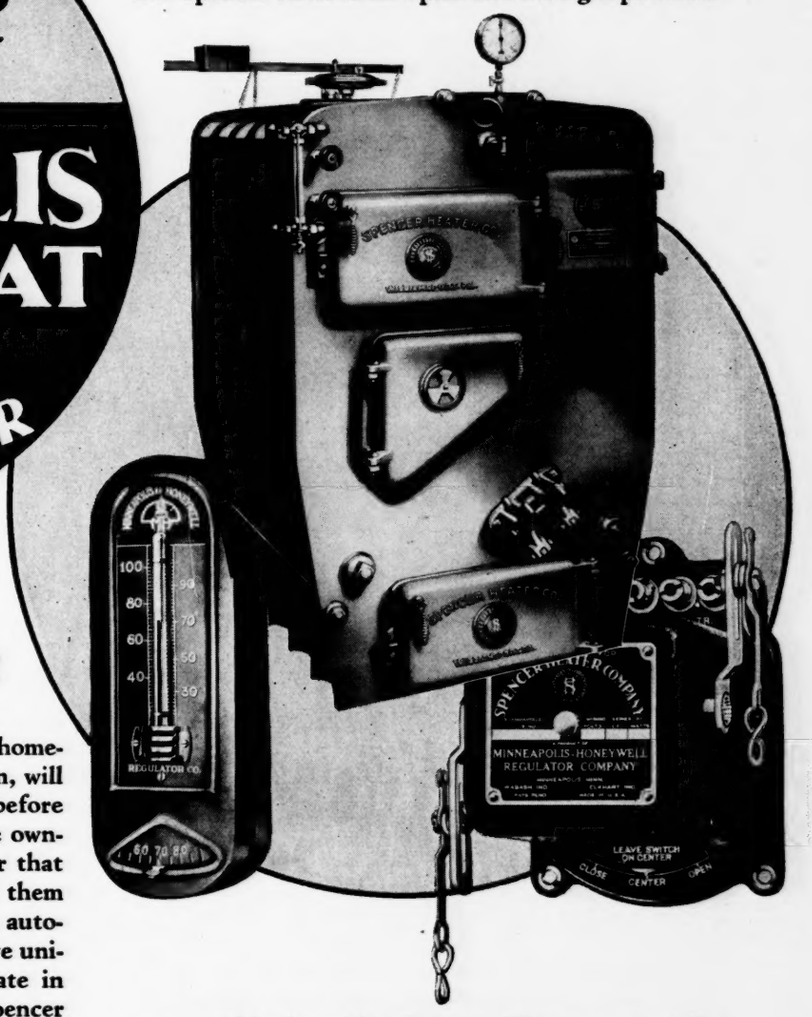
This Automatic Heat *with* Thermostatic Control Is "Tailor-Made" *for* Your 1933 Replacement Campaign!...

CAST IRON SECTIONAL

SPENCER
Magazine Feed
BOILERS
equipped with
MINNEAPOLIS THERMOSTAT
and
ELECTRIC DAMPER MOTOR

as
Standard Equipment

Restored public confidence is paving the way for better and more profitable business. The heating contractors who will share in this improvement are the ones who are aggressively going after replacement business with merchandise designed for today's market. Spencer offers them a plan and the right product.



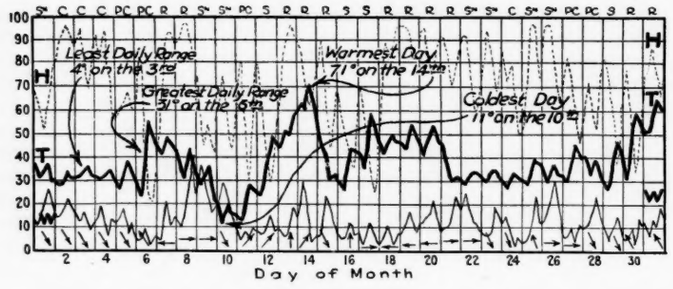
THE market is ready! Thousands of homeowners, many of them in your own town, will *have to* replace their old, worn-out boilers before another heating season. You can sell these owners if you are ready for them with a boiler that meets their rigid requirements. Most of them will demand that the new boiler must be automatic in operation and control. It must give uniform, healthful heat. It must be moderate in cost and low in expense of operation. Spencer Boilers meet ALL these requirements. Spencer Magazine Feed is the original automatic heat using coal, and has been continually perfected to provide uniform heat at all times in all rooms. Now every cast iron Spencer Boiler includes Minneapolis Room Temperature Thermostat and Electric Damper Motor. Spencer has always provided "The Lowest Cost Heat You Can Buy" because it is especially designed to burn small-size, low cost Anthracite or Coke. Do the first replacement job in your own home, by replacing your old boiler with a Spencer. Then you can tell prospects, from first-hand experience, about the comfort, convenience, cleanliness and economy of Spencer Automatic Heat, thermostatically controlled. It means additional profits and prestige for you!

Write for full details about the Spencer sales plan

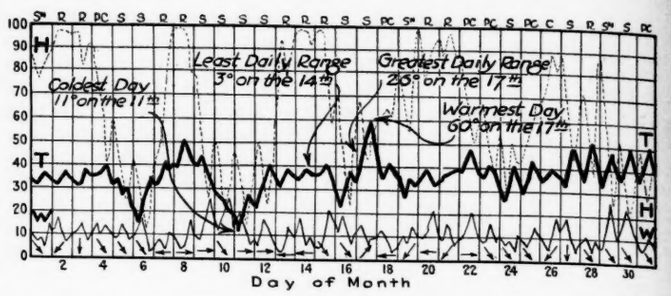
SPENCER HEATER COMPANY, Williamsport, Pa.
Division of Cord Corporation
The Spencer Foundry Company, Ltd., Penetanguishene, Ontario and Montreal, Quebec, Canada

The Weather

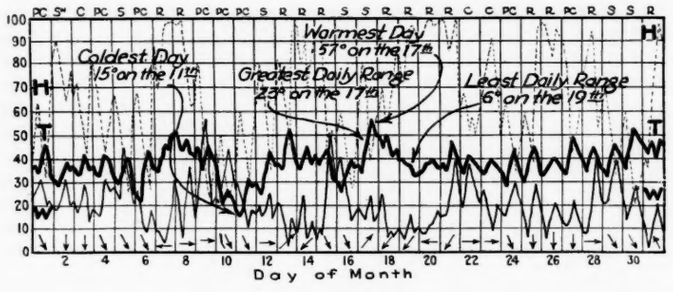
March, 1933



Pittsburgh

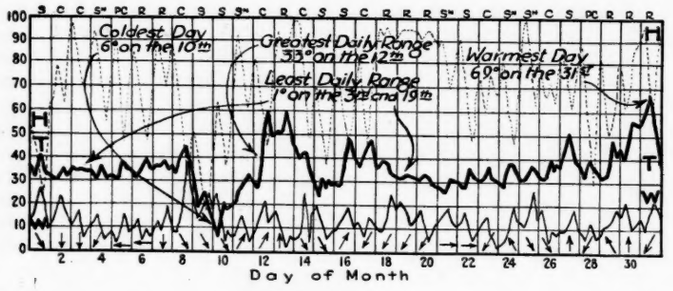


Boston

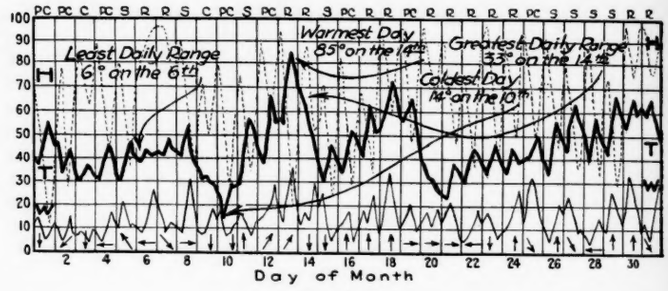


New York

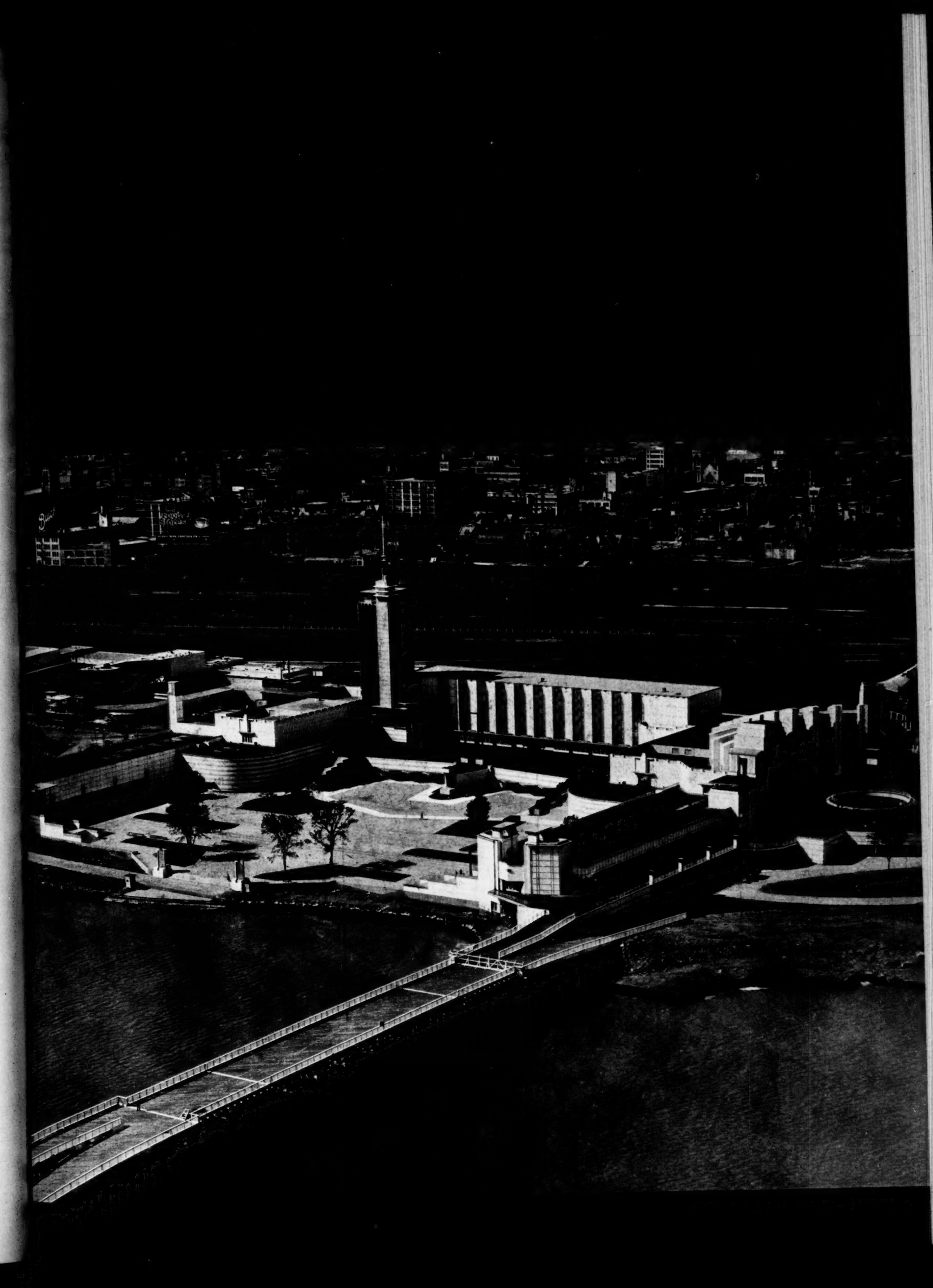
(Hourly observation of the Relative Humidity Plotted on this Chart)



Chicago



St. Louis

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, deg. F.	57	60	71	69	85
Date of highest temperature	17	17	14	31	13
Lowest temperature, deg. F.	15	11	11	6	14
Date of lowest temperature	11	11	10	10	10
Greatest daily range, deg. F.	23	26	31	33	33
Date of greatest daily range	17	17	6	12	14
Least daily range, deg. F.	6	3	4	1	6
Date of least daily range	19	14	3	3.19	6
Mean temperature for month, deg. F.	38.0	35.7	38.0	35.4	44.8
Normal mean temperature for month, deg. F.	37.7	35.6	39.6	35.3	44.1
Total precipitation, this month, inches	5.89	6.80	5.77	4.05	4.91
Total snowfall, this month, inches	3.1	5.1	2.7	6.5	0.1
Normal precipitation, this month, inches	3.64	3.57	3.03	2.58	3.38
Total wind movement, this month, miles	13,509	7,890	8,602	8,849	9,323
Average hourly wind velocity, miles	18.2	10.6	11.6	11.9	12.5
Prevailing direction of wind	N.W.	N.W.	N.W.	N.E.	S.
Number of clear days	6	11	2	6	10
Number of partly cloudy days	10	7	8	5	9
Number of cloudy days	15	13	21	20	12
Number of days with precipitation	14	14	18	15	15
Number of days with snowfall	4	7	9	6	1
Snow on ground, at end of month	None	None	None	None	None

Plotted from records especially compiled for HEATING AND VENTILATING by the United States Weather Bureau.
Heavy lines indicate temperatures in degrees F. **Light lines indicate wind in miles per hour.**
Broken lines indicate humidity in percentage from readings at 8 a.m., 12 m., and 8 p.m.
S—clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow. **Arrows fly with prevailing directions of wind.**